

# **A Longitudinal Analysis of University Rankings: Supplementary Material**

**Friso Selten<sup>1</sup>, Cameron Neylon<sup>2</sup>, Chun-Kai Huang<sup>2</sup>, Paul Groth<sup>1</sup>**

<sup>1</sup>Informatics Institute, University of Amsterdam, Amsterdam, The Netherlands

<sup>2</sup>Centre for Culture and Technology, Curtin University, Perth, Australia

## A. RESULTS OF PRINCIPAL COMPONENT ANALYSIS

**Table 1.** PCA Loadings on Components 2012

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | <b>-0.58</b> | 0.09         |              |
| 2. Award                 | <b>-0.46</b> | 0.06         |              |
| 3. HiCi                  | <b>-0.60</b> | -0.04        |              |
| 4. NS                    | <b>-0.50</b> | -0.16        |              |
| 5. PUB                   | 0.00         | <b>-0.87</b> |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | <b>-0.93</b> | -0.04        |              |
| 2. Research              | <b>-0.96</b> | -0.04        |              |
| 3. Citations             | <b>-0.57</b> | <b>0.61</b>  |              |
| 4. Industry Income       | <b>-0.40</b> | <b>-0.73</b> |              |
| 5. International Outlook | -0.14        | <b>0.57</b>  |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.93</b> | 0.00         | -0.05        |
| 2. Employer reputation   | <b>-0.70</b> | -0.25        | -0.15        |
| 3. Faculty Student       | -0.01        | 0.03         | <b>-0.99</b> |
| 4. International Faculty | 0.02         | <b>-0.95</b> | 0.10         |
| 5. International Student | -0.02        | <b>-0.94</b> | -0.06        |
| 6. Citations             | <b>-0.77</b> | 0.15         | 0.18         |

Note: Loadings larger than .40 are in bold

**Table 2.** PCA Loadings on Components 2014

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | 0.11         | <b>0.64</b>  |              |
| 2. Award                 | 0.02         | <b>0.47</b>  |              |
| 3. HiCi                  | -0.33        | <b>0.42</b>  |              |
| 4. NS                    | -0.28        | <b>0.45</b>  |              |
| 5. PUB                   | <b>-0.88</b> | -0.01        |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | <b>-0.79</b> | -0.06        |              |
| 2. Research              | <b>-0.85</b> | -0.03        |              |
| 3. Citations             | <b>-0.49</b> | <b>0.60</b>  |              |
| 4. Industry Income       | -0.35        | <b>-0.76</b> |              |
| 5. International Outlook | -0.21        | <b>0.59</b>  |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.93</b> | 0.10         | -0.17        |
| 2. Employer reputation   | <b>-0.94</b> | -0.11        | 0.15         |
| 3. Faculty Student       | 0.04         | -0.01        | <b>-0.87</b> |
| 4. International Faculty | 0.03         | <b>-0.96</b> | 0.01         |
| 5. International Student | -0.03        | <b>-0.94</b> | -0.04        |
| 6. Citations             | -0.19        | -0.13        | <b>-0.58</b> |

Note: Loadings larger than .40 are in bold

**Table 3.** PCA Loadings on Components 2013

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | <b>-0.58</b> | 0.09         |              |
| 2. Award                 | <b>-0.45</b> | 0.04         |              |
| 3. HiCi                  | <b>-0.62</b> | -0.01        |              |
| 4. NS                    | <b>-0.52</b> | -0.16        |              |
| 5. PUB                   | 0.00         | <b>-0.88</b> |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | <b>-0.70</b> | -0.22        |              |
| 2. Research              | <b>-0.75</b> | -0.23        |              |
| 3. Citations             | <b>-0.68</b> | <b>0.44</b>  |              |
| 4. Industry Income       | -0.19        | <b>-0.82</b> |              |
| 5. International Outlook | -0.38        | <b>0.54</b>  |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.98</b> | 0.08         | -0.09        |
| 2. Employer reputation   | <b>-0.90</b> | -0.12        | 0.13         |
| 3. Faculty Student       | 0.03         | -0.02        | <b>-0.94</b> |
| 4. International Faculty | 0.03         | <b>-0.97</b> | 0.03         |
| 5. International Student | -0.03        | <b>-0.94</b> | -0.05        |
| 6. Citations             | -0.38        | -0.08        | <b>-0.43</b> |

Note: Loadings larger than .40 are in bold

**Table 4.** PCA Loadings on Components 2015

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | <b>-0.63</b> | 0.14         |              |
| 2. Award                 | <b>-0.48</b> | 0.04         |              |
| 3. HiCi                  | <b>-0.47</b> | -0.27        |              |
| 4. NS                    | <b>-0.50</b> | -0.22        |              |
| 5. PUB                   | 0.00         | <b>-0.87</b> |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | <b>-0.41</b> | <b>-0.40</b> |              |
| 2. Research              | <b>-0.50</b> | <b>-0.44</b> |              |
| 3. Citations             | <b>-0.86</b> | -0.13        |              |
| 4. Industry Income       | 0.05         | <b>-1.00</b> |              |
| 5. International Outlook | <b>-0.88</b> | 0.22         |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.94</b> | -0.06        | -0.01        |
| 2. Employer reputation   | <b>-0.93</b> | 0.10         | 0.08         |
| 3. Faculty Student       | 0.00         | 0.02         | <b>-0.99</b> |
| 4. International Faculty | 0.02         | <b>0.89</b>  | 0.00         |
| 5. International Student | -0.02        | <b>1.00</b>  | -0.02        |
| 6. Citations             | <b>-0.69</b> | -0.07        | -0.25        |

Note: Loadings larger than .40 are in bold

**Table 5.** PCA Loadings on Components 2016

| Measure                  | PC1          | PC2          | PC3         |
|--------------------------|--------------|--------------|-------------|
| <b>ARWU</b>              |              |              |             |
| 1. Alumni                | 0.05         | <b>0.67</b>  |             |
| 2. Award                 | -0.04        | <b>0.46</b>  |             |
| 3. HiCi                  | <b>-0.63</b> | 0.04         |             |
| 4. NS                    | -0.37        | 0.37         |             |
| 5. PUB                   | <b>-0.85</b> | -0.03        |             |
| <b>THE</b>               |              |              |             |
| 1. Teaching              | -0.33        | <b>-0.47</b> |             |
| 2. Research              | <b>-0.46</b> | <b>-0.47</b> |             |
| 3. Citations             | <b>-0.85</b> | -0.21        |             |
| 4. Industry Income       | 0.08         | <b>-0.90</b> |             |
| 5. International Outlook | <b>-0.96</b> | 0.19         |             |
| <b>QS</b>                |              |              |             |
| 1. Academic reputation   | <b>-0.61</b> | 0.04         | <b>0.59</b> |
| 2. Employer reputation   | <b>-0.67</b> | -0.16        | 0.35        |
| 3. Faculty Student       | <b>-0.93</b> | 0.01         | -0.20       |
| 4. International Faculty | 0.11         | <b>-0.95</b> | 0.04        |
| 5. International Student | -0.12        | <b>-0.93</b> | -0.05       |
| 6. Citations             | 0.09         | -0.04        | <b>0.96</b> |

Note: Loadings larger than .40 are in bold

**Table 7.** PCA Loadings on Components 2017

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | 0.03         | <b>0.67</b>  |              |
| 2. Award                 | -0.05        | <b>0.47</b>  |              |
| 3. HiCi                  | <b>-0.69</b> | -0.08        |              |
| 4. NS                    | <b>-0.40</b> | 0.30         |              |
| 5. PUB                   | <b>-0.78</b> | 0.03         |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | -0.35        | <b>-0.40</b> |              |
| 2. Research              | <b>-0.47</b> | <b>-0.43</b> |              |
| 3. Citations             | <b>-0.89</b> | -0.11        |              |
| 4. Industry Income       | 0.05         | <b>-0.95</b> |              |
| 5. International Outlook | <b>-0.95</b> | 0.14         |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.90</b> | 0.08         | -0.27        |
| 2. Employer reputation   | <b>-0.76</b> | -0.13        | -0.34        |
| 3. Faculty Student       | -0.10        | -0.03        | <b>-0.92</b> |
| 4. International Faculty | 0.02         | <b>-0.92</b> | -0.01        |
| 5. International Student | 0.00         | <b>-0.95</b> | 0.00         |
| 6. Citations             | <b>-0.88</b> | -0.06        | <b>0.46</b>  |

Note: Loadings larger than .40 are in bold

**Table 6.** PCA Loadings on Components 2018

| Measure                  | PC1          | PC2          | PC3          |
|--------------------------|--------------|--------------|--------------|
| <b>ARWU</b>              |              |              |              |
| 1. Alumni                | 0.04         | <b>0.66</b>  |              |
| 2. Award                 | -0.03        | <b>0.48</b>  |              |
| 3. HiCi                  | <b>-0.66</b> | -0.02        |              |
| 4. NS                    | -0.36        | 0.35         |              |
| 5. PUB                   | <b>-0.84</b> | -0.01        |              |
| <b>THE</b>               |              |              |              |
| 1. Teaching              | -0.28        | <b>-0.45</b> |              |
| 2. Research              | <b>-0.42</b> | <b>-0.45</b> |              |
| 3. Citations             | <b>-0.89</b> | -0.12        |              |
| 4. Industry Income       | 0.07         | <b>-0.88</b> |              |
| 5. International Outlook | <b>-0.96</b> | 0.12         |              |
| <b>QS</b>                |              |              |              |
| 1. Academic reputation   | <b>-0.99</b> | -0.05        | 0.03         |
| 2. Employer reputation   | <b>-0.92</b> | 0.04         | 0.10         |
| 3. Faculty Student       | -0.15        | 0.04         | <b>0.92</b>  |
| 4. International Faculty | 0.01         | <b>0.94</b>  | -0.08        |
| 5. International Student | 0.02         | <b>0.95</b>  | 0.10         |
| 6. Citations             | <b>-0.55</b> | 0.14         | <b>-0.58</b> |

Note: Loadings larger than .40 are in bold

## B. RESULTS OF FACTOR ANALYSIS

**Table 8.** NIPA Loadings on Factors 2012

| Measure                  | PA1         | PA2         | PA3         |
|--------------------------|-------------|-------------|-------------|
| <b>ARWU</b>              |             |             |             |
| 1. Alumni                | 0.04        | <b>0.79</b> |             |
| 2. Award                 | 0.01        | <b>0.85</b> |             |
| 3. HiCi                  | <b>0.82</b> | 0.07        |             |
| 4. NS                    | <b>0.81</b> | 0.14        |             |
| 5. PUB                   | <b>0.83</b> | -0.15       |             |
| <b>THE</b>               |             |             |             |
| 1. Teaching              | <b>0.94</b> | 0.01        |             |
| 2. Research              | <b>0.95</b> | 0.01        |             |
| 3. Citations             | 0.32        | <b>0.43</b> |             |
| 4. Industry Income       | 0.38        | -0.36       |             |
| 5. International Outlook | 0.06        | 0.25        |             |
| <b>QS</b>                |             |             |             |
| 1. Academic reputation   | <b>0.76</b> | -0.04       | 0.18        |
| 2. Employer reputation   | <b>0.81</b> | 0.06        | -0.12       |
| 3. Faculty Student       | 0.19        | -0.02       | 0.09        |
| 4. International Faculty | -0.05       | <b>0.78</b> | 0.02        |
| 5. International Student | 0.06        | <b>0.76</b> | 0.00        |
| 6. Citations             | 0.16        | 0.07        | <b>0.41</b> |

Note: Loadings larger than .40 are in bold

**Table 9.** NIPA Loadings on Factors 2014

| Measure                      | PA1         | PA2         | PA3         |
|------------------------------|-------------|-------------|-------------|
| <b>ARWU</b>                  |             |             |             |
| 1. Alumni                    | 0.03        | <b>0.80</b> |             |
| 2. Award                     | 0.03        | <b>0.84</b> |             |
| 3. HiCi                      | <b>0.87</b> | 0.03        |             |
| 4. NS                        | <b>0.75</b> | 0.22        |             |
| 5. PUB                       | <b>0.82</b> | -0.14       |             |
| <b>THE</b>                   |             |             |             |
| 1. Teaching                  | <b>0.94</b> | -0.01       |             |
| 2. Research                  | <b>0.95</b> | 0.02        |             |
| 3. Citations                 | 0.27        | <b>0.40</b> |             |
| 4. Industry Income           | 0.33        | -0.35       |             |
| 5. International Outlook     | 0.09        | 0.31        |             |
| <b>QS</b>                    |             |             |             |
| 1. Academic reputation -0.17 | <b>0.78</b> | -0.06       | 0.22        |
| 2. Employer reputation       | <b>0.82</b> | 0.08        | -0.16       |
| 3. Faculty Student           | 0.15        | 0.06        | 0.11        |
| 4. International Faculty     | -0.02       | <b>0.77</b> | 0.00        |
| 5. International Student     | 0.03        | <b>0.77</b> | 0.03        |
| 6. Citations                 | 0.08        | 0.15        | <b>0.50</b> |

Note: Loadings larger than .40 are in bold

**Table 10.** NIPA Loadings on Factors 2013

| Measure                  | PA1         | PA2         | PA3         |
|--------------------------|-------------|-------------|-------------|
| <b>ARWU</b>              |             |             |             |
| 1. Alumni                | 0.03        | <b>0.79</b> |             |
| 2. Award                 | 0.02        | <b>0.84</b> |             |
| 3. HiCi                  | <b>0.81</b> | 0.06        |             |
| 4. NS                    | <b>0.81</b> | 0.14        |             |
| 5. PUB                   | <b>0.82</b> | -0.15       |             |
| <b>THE</b>               |             |             |             |
| 1. Teaching              | <b>0.93</b> | 0.00        |             |
| 2. Research              | <b>0.94</b> | 0.01        |             |
| 3. Citations             | 0.31        | <b>0.40</b> |             |
| 4. Industry Income       | 0.36        | -0.34       |             |
| 5. International Outlook | 0.08        | 0.27        |             |
| <b>QS</b>                |             |             |             |
| 1. Academic reputation   | <b>0.76</b> | -0.05       | 0.23        |
| 2. Employer reputation   | <b>0.82</b> | 0.08        | -0.15       |
| 3. Faculty Student       | 0.13        | 0.04        | 0.14        |
| 4. International Faculty | -0.03       | <b>0.79</b> | 0.02        |
| 5. International Student | 0.03        | <b>0.79</b> | 0.01        |
| 6. Citations             | 0.09        | 0.14        | <b>0.51</b> |

Note: Loadings larger than .40 are in bold

**Table 11.** NIPA Loadings on Factors 2015

| Measure                  | PA1         | PA2         | PA3   |
|--------------------------|-------------|-------------|-------|
| <b>ARWU</b>              |             |             |       |
| 1. Alumni                | 0.04        | <b>0.80</b> |       |
| 2. Award                 | 0.03        | <b>0.84</b> |       |
| 3. HiCi                  | <b>0.86</b> | 0.05        |       |
| 4. NS                    | <b>0.75</b> | 0.22        |       |
| 5. PUB                   | <b>0.81</b> | -0.16       |       |
| <b>THE</b>               |             |             |       |
| 1. Teaching              | <b>0.95</b> | -0.04       |       |
| 2. Research              | <b>0.89</b> | 0.10        |       |
| 3. Citations             | 0.22        | <b>0.57</b> |       |
| 4. Industry Income       | <b>0.46</b> | -0.18       |       |
| 5. International Outlook | -0.06       | <b>0.66</b> |       |
| <b>QS</b>                |             |             |       |
| 1. Academic reputation   | <b>0.87</b> | -0.07       | 0.02  |
| 2. Employer reputation   | <b>0.84</b> | 0.07        | -0.04 |
| 3. Faculty Student       | 0.39        | 0.10        | 0.14  |
| 4. International Faculty | -0.03       | <b>0.69</b> | -0.01 |
| 5. International Student | 0.03        | <b>0.70</b> | 0.01  |
| 6. Citations             | <b>0.46</b> | -0.01       | 0.10  |

Note: Loadings larger than .40 are in bold

**Table 12.** NIPA Loadings on Factors 2016

| Measure                  | PA1         | PA2         | PA3   |
|--------------------------|-------------|-------------|-------|
| <b>ARWU</b>              |             |             |       |
| 1. Alumni                | <b>0.84</b> | -0.01       |       |
| 2. Award                 | <b>0.84</b> | 0.03        |       |
| 3. HiCi                  | -0.02       | <b>0.80</b> |       |
| 4. NS                    | 0.37        | <b>0.60</b> |       |
| 5. PUB                   | -0.07       | <b>0.75</b> |       |
| <b>THE</b>               |             |             |       |
| 1. Teaching              | <b>0.95</b> | -0.04       |       |
| 2. Research              | <b>0.86</b> | 0.14        |       |
| 3. Citations             | 0.24        | <b>0.61</b> |       |
| 4. Industry Income       | <b>0.57</b> | -0.18       |       |
| 5. International Outlook | -0.06       | <b>0.71</b> |       |
| <b>QS</b>                |             |             |       |
| 1. Academic reputation   | <b>0.87</b> | -0.06       | 0.07  |
| 2. Employer reputation   | <b>0.76</b> | 0.11        | -0.07 |
| 3. Faculty Student       | <b>0.50</b> | -0.05       | -0.20 |
| 4. International Faculty | -0.06       | <b>0.73</b> | 0.03  |
| 5. International Student | 0.07        | <b>0.72</b> | -0.02 |
| 6. Citations             | <b>0.40</b> | 0.12        | 0.31  |

Note: Loadings larger than .40 are in bold

**Table 14.** NIPA Loadings on Factors 2017

| Measure                  | PA1         | PA2         | PA3   |
|--------------------------|-------------|-------------|-------|
| <b>ARWU</b>              |             |             |       |
| 1. Alumni                | <b>0.84</b> | 0.00        |       |
| 2. Award                 | <b>0.85</b> | 0.03        |       |
| 3. HiCi                  | -0.04       | <b>0.80</b> |       |
| 4. NS                    | 0.34        | <b>0.63</b> |       |
| 5. PUB                   | -0.07       | <b>0.74</b> |       |
| <b>THE</b>               |             |             |       |
| 1. Teaching              | <b>0.94</b> | -0.03       |       |
| 2. Research              | <b>0.88</b> | 0.13        |       |
| 3. Citations             | 0.20        | <b>0.64</b> |       |
| 4. Industry Income       | <b>0.59</b> | -0.18       |       |
| 5. International Outlook | -0.06       | <b>0.74</b> |       |
| <b>QS</b>                |             |             |       |
| 1. Academic reputation   | <b>0.87</b> | -0.09       | 0.05  |
| 2. Employer reputation   | <b>0.76</b> | 0.14        | -0.05 |
| 3. Faculty Student       | 0.38        | -0.01       | -0.31 |
| 4. International Faculty | -0.03       | <b>0.69</b> | 0.01  |
| 5. International Student | 0.02        | <b>0.68</b> | 0.00  |
| 6. Citations             | 0.36        | 0.11        | 0.35  |

Note: Loadings larger than .40 are in bold

**Table 13.** NIPA Loadings on Factors 2018

| Measure                  | PA1         | PA2         | PA3          |
|--------------------------|-------------|-------------|--------------|
| <b>ARWU</b>              |             |             |              |
| 1. Alumni                | <b>0.84</b> | 0.00        |              |
| 2. Award                 | <b>0.86</b> | 0.01        |              |
| 3. HiCi                  | 0.01        | <b>0.79</b> |              |
| 4. NS                    | <b>0.41</b> | <b>0.58</b> |              |
| 5. PUB                   | -0.09       | <b>0.75</b> |              |
| <b>THE</b>               |             |             |              |
| 1. Teaching              | <b>0.92</b> | -0.02       |              |
| 2. Research              | <b>0.86</b> | 0.15        |              |
| 3. Citations             | 0.16        | <b>0.66</b> |              |
| 4. Industry Income       | <b>0.63</b> | -0.20       |              |
| 5. International Outlook | -0.04       | <b>0.73</b> |              |
| <b>QS</b>                |             |             |              |
| 1. Academic reputation   | <b>0.88</b> | -0.06       | 0.07         |
| 2. Employer reputation   | <b>0.83</b> | 0.08        | -0.08        |
| 3. Faculty Student       | 0.24        | -0.01       | <b>-0.40</b> |
| 4. International Faculty | -0.02       | <b>0.75</b> | 0.07         |
| 5. International Student | 0.02        | <b>0.76</b> | -0.06        |
| 6. Citations             | 0.26        | 0.13        | <b>0.44</b>  |

Note: Loadings larger than .40 are in bold

**C. CORRELATIONS BETWEEN CONCEPTS**

**Table 15.** Spearman correlations between concepts

|                     | 1       | 2       | 3       | 4       | 5       |
|---------------------|---------|---------|---------|---------|---------|
| <b>2018</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.56*** |         |         |         |         |
| 3. QS Publication   | 0.40*** | 0.40*** |         |         |         |
| 4. ARWU Reputation  | 0.45*** | 0.46*** | 0.19*** |         |         |
| 5. THE Reputation   | 0.71*** | 0.44*** | 0.53*** | 0.51*** |         |
| 6. QS Reputation    | 0.56*** | 0.24*** | 0.34*** | 0.40*** | 0.74*** |
| <b>2017</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.69*** |         |         |         |         |
| 3. QS Publication   | 0.40*** | 0.44*** |         |         |         |
| 4. ARWU Reputation  | 0.64*** | 0.67*** | 0.30*** |         |         |
| 5. THE Reputation   | 0.79*** | 0.59*** | 0.56*** | 0.59*** |         |
| 6. QS Reputation    | 0.67*** | 0.47*** | 0.40*** | 0.49*** | 0.83*** |
| <b>2016</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.72*** |         |         |         |         |
| 3. QS Publication   | 0.46*** | 0.54*** |         |         |         |
| 4. ARWU Reputation  | 0.62*** | 0.65*** | 0.36*** |         |         |
| 5. THE Reputation   | 0.77*** | 0.64*** | 0.56*** | 0.59*** |         |
| 6. QS Reputation    | 0.68*** | 0.50*** | 0.46*** | 0.50*** | 0.84*** |
| <b>2015</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.72*** |         |         |         |         |
| 3. QS Publication   | 0.40*** | 0.45*** |         |         |         |
| 4. ARWU Reputation  | 0.72*** | 0.64*** | 0.39*** |         |         |
| 5. THE Reputation   | 0.81*** | 0.67*** | 0.54*** | 0.69*** |         |
| 6. QS Reputation    | 0.72*** | 0.48*** | 0.49*** | 0.60*** | 0.84*** |
| <b>2014</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.55*** |         |         |         |         |
| 3. QS Publication   | 0.61*** | 0.60*** |         |         |         |
| 4. ARWU Reputation  | 0.53*** | 0.52*** | 0.41*** |         |         |
| 5. THE Reputation   | 0.72*** | 0.38*** | 0.58*** | 0.44*** |         |
| 6. QS Reputation    | 0.53*** | 0.18**  | 0.25*** | 0.36*** | 0.70*** |
| <b>2013</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.52*** |         |         |         |         |
| 3. QS Publication   | 0.62*** | 0.58*** |         |         |         |
| 4. ARWU Reputation  | 0.56*** | 0.53*** | 0.44*** |         |         |
| 5. THE Reputation   | 0.70*** | 0.40*** | 0.59*** | 0.44*** |         |
| 6. QS Reputation    | 0.53*** | 0.23*** | 0.26*** | 0.36*** | 0.68*** |
| <b>2012</b>         |         |         |         |         |         |
| 1. ARWU Publication |         |         |         |         |         |
| 2. THE Publication  | 0.56*** |         |         |         |         |
| 3. QS Publication   | 0.66*** | 0.62*** |         |         |         |
| 4. ARWU Reputation  | 0.52*** | 0.51*** | 0.41*** |         |         |
| 5. THE Reputation   | 0.74*** | 0.45*** | 0.57*** | 0.45*** |         |
| 6. QS Reputation    | 0.50*** | 0.25*** | 0.22*** | 0.34*** | 0.68*** |

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

# D. CORRELATIONS BETWEEN VARIABLES FOR THE 2018 RANKINGS

**Table 16.** Means, standard deviations, and correlations of variables within rankings

| Measure                   | Mean  | SD    | Correlations |         |          |         |         |         |
|---------------------------|-------|-------|--------------|---------|----------|---------|---------|---------|
|                           |       |       | 1.           | 2.      | 3.       | 4.      | 5.      | 6.      |
| ARWU                      |       |       |              |         |          |         |         |         |
| 1. Alumni                 | 23.54 | 18.50 |              |         |          |         |         |         |
| 2. Award                  | 27.34 | 23.47 | 0.64         |         |          |         |         |         |
| 3. HiCi                   | 33.71 | 14.43 | 0.06         | 0.16    |          |         |         |         |
| 4. NS                     | 31.93 | 15.10 | 0.46***      | 0.54*** | 0.54***  |         |         |         |
| 5. PUB                    | 57.43 | 12.99 | 0.15         | 0.02    | 0.50***  | 0.45*** |         |         |
| 6. PCP                    | 35.09 | 13.47 | 0.24*        | 0.38*** | 0.37***  | 0.29**  | −0.15   |         |
| 7. Overall Score          | 36.70 | 12.87 | 0.57***      | 0.69*** | 0.61***  | 0.84*** | 0.53*** | 0.36*** |
| THE                       |       |       |              |         |          |         |         |         |
| 1. Teaching               | 54.04 | 16.32 |              |         |          |         |         |         |
| 2. Research               | 56.12 | 18.00 | 0.82**       |         |          |         |         |         |
| 3. Citations              | 85.69 | 12.00 | 0.18*        | 0.17*   |          |         |         |         |
| 4. Industry Income        | 59.35 | 20.46 | 0.19**       | 0.30*** | −0.23**  |         |         |         |
| 5. International Outlook  | 71.26 | 18.51 | −0.19**      | 0.04    | 0.11     | −0.11   |         |         |
| 6. Overall Score          | 69.17 | 39.30 | 0.80***      | 0.87*** | 0.48***  | 0.17*   | 0.12    |         |
| QS                        |       |       |              |         |          |         |         |         |
| 1. Academic reputation    | 40.07 | 26.85 |              |         |          |         |         |         |
| 2. Employer reputation    | 40.38 | 28.16 | 0.76***      |         |          |         |         |         |
| 3. Faculty Student        | 51.99 | 30.19 | 0.08         | 0.09*   |          |         |         |         |
| 4. International Faculty  | 53.98 | 34.99 | 0.19***      | 0.25*** | −0.05    |         |         |         |
| 5. International Students | 47.74 | 32.45 | 0.16***      | 0.26*** | 0.03     | 0.67*** |         |         |
| 6. Citations              | 44.19 | 26.88 | 0.41***      | 0.26*** | −0.21*** | 0.32*** | 0.24*** |         |
| 7. Overall Score          | 44.50 | 18.66 | 0.85***      | 0.73*** | 0.32***  | 0.38*** | 0.38*** | 0.55*** |

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

**E. CRONBACH'S ALPHA FOR COMPLETE RANKING**

**Table 17.** Standardized Cronbach's alpha for complete ranking

|      | ARWU | THE  | QS   |
|------|------|------|------|
| 2018 | 0.88 | 0.82 | 0.67 |
| 2017 | 0.88 | 0.82 | 0.67 |
| 2016 | 0.89 | 0.82 | 0.72 |
| 2015 | 0.9  | 0.78 | 0.67 |
| 2014 | 0.91 | 0.62 | 0.67 |
| 2013 | 0.90 | 0.64 | 0.69 |
| 2012 | 0.91 | 0.64 | 0.66 |



## F. SIMILARITY BETWEEN RANKING YEARS OVERALL

**Table 18.** Similarity between ranking years (O: Overlap; F: Spearmans correlation coefficient, M: M-measure).

| Measure     | 2012 |      |      | 2013 |      |      | 2014 |      |      | 2015 |      |      | 2016 |      |      | 2017 |      |      |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|             | O    | F    | M    | O    | F    | M    | O    | F    | M    | O    | F    | M    | O    | F    | M    | O    | F    | M    |
| <b>ARWU</b> |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2013        | 489  | 0.99 | 0.97 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2014        | 467  | 0.95 | 0.96 | 473  | 0.96 | 0.95 |      |      |      |      |      |      |      |      |      |      |      |      |
| 2015        | 468  | 0.94 | 0.96 | 472  | 0.95 | 0.95 | 485  | 0.99 | 0.98 |      |      |      |      |      |      |      |      |      |
| 2016        | 440  | 0.87 | 0.9  | 446  | 0.88 | 0.92 | 458  | 0.94 | 0.93 | 459  | 0.95 | 0.93 |      |      |      |      |      |      |
| 2017        | 432  | 0.87 | 0.89 | 438  | 0.88 | 0.89 | 448  | 0.94 | 0.92 | 449  | 0.94 | 0.92 | 467  | 0.97 | 0.94 |      |      |      |
| 2018        | 432  | 0.86 | 0.88 | 434  | 0.87 | 0.88 | 443  | 0.93 | 0.91 | 444  | 0.94 | 0.91 | 459  | 0.96 | 0.93 | 471  | 0.98 | 0.97 |
| <b>THE</b>  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2013        | 338  | 0.98 | 0.91 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2014        | 324  | 0.95 | 0.89 | 334  | 0.97 | 0.93 |      |      |      |      |      |      |      |      |      |      |      |      |
| 2015        | 301  | 0.91 | 0.86 | 303  | 0.92 | 0.88 | 307  | 0.92 | 0.85 |      |      |      |      |      |      |      |      |      |
| 2016        | 297  | 0.9  | 0.78 | 299  | 0.91 | 0.79 | 303  | 0.91 | 0.77 | 331  | 0.97 | 0.86 |      |      |      |      |      |      |
| 2017        | 289  | 0.89 | 0.72 | 291  | 0.9  | 0.74 | 297  | 0.9  | 0.71 | 320  | 0.94 | 0.8  | 335  | 0.98 | 0.92 |      |      |      |
| 2018        | 277  | 0.86 | 0.7  | 278  | 0.87 | 0.72 | 286  | 0.88 | 0.7  | 307  | 0.93 | 0.78 | 319  | 0.96 | 0.89 | 342  | 0.97 | 0.95 |
| <b>QS</b>   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2013        | 376  | 0.99 | 0.92 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2014        | 370  | 0.97 | 0.89 | 384  | 0.99 | 0.91 |      |      |      |      |      |      |      |      |      |      |      |      |
| 2015        | 368  | 0.95 | 0.83 | 373  | 0.96 | 0.88 | 371  | 0.96 | 0.85 |      |      |      |      |      |      |      |      |      |
| 2016        | 359  | 0.94 | 0.82 | 365  | 0.95 | 0.84 | 364  | 0.96 | 0.84 | 381  | 0.99 | 0.94 |      |      |      |      |      |      |
| 2017        | 357  | 0.93 | 0.81 | 361  | 0.94 | 0.83 | 361  | 0.95 | 0.82 | 375  | 0.98 | 0.91 | 384  | 0.98 | 0.96 |      |      |      |
| 2018        | 354  | 0.91 | 0.8  | 356  | 0.92 | 0.8  | 357  | 0.93 | 0.8  | 367  | 0.96 | 0.88 | 374  | 0.97 | 0.93 | 383  | 0.99 | 0.95 |

All Spearmans correlations (F) were significant:  $p < .001$

For the ARWU the top 500 and for the THE and QS the top 400 universities are analysed

When interpreting these results one has to take into account two considerations:

1. Results for the ARWU and THE are largely based on re-calculated ranks. These ranks are not provided by the rankings
2. For certain universities re-calculation because data was missing proved impossible. These were removed from the analysis.

## G. SIMILARITY BETWEEN DIFFERENT RANKINGS OVERALL

**Table 19.** Similarity between different rankings (O: Overlap; F: Spearman correlation coefficient; M: M-measure)

| Measure   | Top 400 |         |      |     |         |      |
|---|---------|---------|------|-----|---------|------|
|   | ARWU    |         |      | THE |         |      |
|   | O       | F       | M    | O   | F       | M    |
| <b>2012</b>                                       |         |         |      |     |         |      |
| THE   | 270     | 0.74*** | 0.6  |     |         |      |
| QS  | 301     | 0.67*** | 0.56 | 278 | 0.82*** | 0.57 |
| <b>2013</b>                                       |         |         |      |     |         |      |
| THE   | 273     | 0.72*** | 0.56 |     |         |      |
| QS  | 309     | 0.68*** | 0.58 | 278 | 0.82*** | 0.57 |
| <b>2014</b>                                       |         |         |      |     |         |      |
| THE   | 275     | 0.73*** | 0.6  |     |         |      |
| QS  | 302     | 0.67*** | 0.56 | 281 | 0.8***  | 0.56 |
| <b>2015</b>                                       |         |         |      |     |         |      |
| THE   | 276     | 0.72*** | 0.54 |     |         |      |
| QS  | 299     | 0.63*** | 0.6  | 274 | 0.78*** | 0.59 |
| <b>2016</b>                                       |         |         |      |     |         |      |
| THE   | 272     | 0.75*** | 0.57 |     |         |      |
| QS  | 291     | 0.66*** | 0.61 | 276 | 0.81*** | 0.6  |
| <b>2017</b>                                       |         |         |      |     |         |      |
| THE   | 267     | 0.74*** | 0.57 |     |         |      |
| QS  | 288     | 0.67*** | 0.61 | 278 | 0.8***  | 0.6  |
| <b>2018</b>                                       |         |         |      |     |         |      |
| THE   | 270     | 0.74*** | 0.58 |     |         |      |
| QS  | 290     | 0.67*** | 0.6  | 275 | 0.82*** | 0.61 |
| Note: * $p < .05$ , ** $p < .01$ , *** $p < .001$ |         |         |      |     |         |      |

When interpreting these results one has to take into account two considerations:

1. Results for the ARWU and THE are largely based on re-calculated ranks. These ranks are not provided by the rankings
2. For certain universities re-calculation because data was missing proved impossible. These were removed from the analysis.