University rankings game and its relation to GDP per capita and GDP growth

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Abstract

In this study, the term 'World-Class Universities per capita' or 'WCUs per capita' is created and defined as the number of world-class universities available in a country divided by its population. To date, it is known that global university rankings are solely the numerical measures of world-class universities. ARWU is chosen as the benchmark of wold-class universities (WCUs) among the university ranking methodologies available based on the assumption that universities listed under Top 500 are WCUs. Simple regression analysis is carried out to determine the correlation between WCUs per capita and GDP per capita as well as GDP growth. The results show that WCUs per capita is strongly correlated to the nation's GDP per capita. However, the WCUs per capita has an insignificant effect on GDP growth. There is a pronounced increase in significance level when the ranking lists are expanded from the Top 100 to Top 500. This suggests that it is crucial for a nation to increase the number of WCUs (listed in the Top 500) in order to attain a higher GDP per capita, rather than having a few elite WCUs in the Top 100. In addition, 'freedom from corruption' is the most significant institutional factor when institutional factors are added into the regression model, followed by 'property rights', 'business freedom' and 'investment freedom'.

Keywords: university rankings; GDP per capita; GDP growth

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Introduction

Recently, the term 'world-class university' has become the buzzword to describe research universities as the pinnacle of tertiary education hierarchy (Salmi, 2009). A world-class research university is crucial in enhancing a nation's competitiveness in the global knowledge economy (Wang et al., 2013). Salmi (2009) defined world-class universities as those possessing the following characteristics: '(a) a high concentration of talent; (b) abundant resources to offer a rich learning environment and for conducting advanced research; and (c) favourable governance features that encourage strategic vision, innovation, and flexibility and that enable institutions to make decisions and to manage resources without being encumbered by bureaucracy'.

There is universal recognition on the importance of building world-class research universities in almost every country (Altbach 2011). Many countries aim at building at least one or more world class research universities. A number of strategic funding programmes have been implemented by various countries in order to promote excellence such as China's 985 Project, Japan's Centres of Excellence, Korea's Brain Korea 21 and Germany's Centres of Excellence. Selected universities in these countries are given additional funds to further develop their expertise in teaching and research (Wang et al., 2012).

In an age of academic hype, it can be observed that numerous universities intend to claim the esteemed status of world-class universities (Altbach 2004). However, the main question to be asked is: 'How do we identify which university is world-class and superior over other universities, especially when students make their lifetime educational choices?' University rankings have emerged over the years in order to fulfil this informational need.

The history of university rankings dates back to 1983, when US News and World Reports started the first annual publication of 'America's Best Colleges', and other countries quickly followed suit to publish their own national rankings. Initially, the rankings were limited to the context of only one country. But the rapid increase in the mobility of students due to economic integration and globalization has made universities more international in nature. It is no longer sufficient for universities to compete with universities from their own countries. They must compete in a global environment and many of the universities expect being considered as 'World-Class Universities'. In 2003, Shanghai Jiaotong University published its first Academic Ranking of World Universities (ARWU), which is the precursor of an academic ranking of universities globally. After this initiative, many other entities published different versions of global university rankings as well.

(An excerpt from Casal et al., 2007)

According to Usher and Savino (2007), university rankings are lists of academic institutions ranked according to a common set of indicators in descending order, and they are usually presented in the format of a league table, in which universities are listed from best to worst.

Hence, the next question is: 'How do we properly rank these universities?' It is generally known that a university carries out both teaching and research, and thus it may be necessary to measure both teaching and research quality in order to obtain to an overall picture of university quality. However, Liu and Cheng (2005) noted that it is debatable whether it is possible to directly measure teaching or education quality of universities. They argued that the only possible way to objectively rank universities is to rank their research performance based on internationally comparable data in which all parties can verify. It shall be highlighted that N.C. Liu is the founder of the Academic Ranking of World Universities (ARWU) at Shanghai Jiaotong University and ARWU will be used to rank university quality in this study. ARWU is chosen since it is regarded as the most objective and comprehensive indicator of university quality (Li et al., 2009; Marginson, 2007; Taylor and Braddock, 2007; Hazelkorn, 2007). In contrast, the THES-QS ranking relies heavily on peer reviews, which are heavily criticized for being too subjective and leading to high volatility of ranking results (Li et al., 2009).
Even though many university administrators abhor 'this form of detailed numerical ordering of the institutions' (Monks and Ehrenberg 1999), Merisotis (2002) noted that university rankings are here to stay. Although university rankings are by no means perfect, they provide information on the quality of institutes of higher education (Usher and Savino 2007). In fact, students use rankings as a basis to decide which university to attend (Hazelkorn 2008; Dill and Soo, 2004). Even though university rankings generally measure the universities' research performance, students use such rankings to help them decide which college they should attend. Machung (1998) also found that two-thirds of parents felt that rankings are very useful in evaluating a college's quality. Therefore, in view of this phenomenon, many universities implement rankings as part of their strategic plans for improvement as well as marketing strategy (Usher and Savino 2007). For example, Cornell University worked on improving its rankings even though such rankings had negligible effect on the university's academic quality (Monks and Ehrenberg, 1999).

Countries, politicians and universities often express their vision to see their universities to among the Top 20 or Top 100, or a part of the ranking lists in the future (EUA Report, 2011). However, this vision may be unrealistic for many countries as there can only be 500 universities listed among the Top 500 by definition. The 'university

rankings game' is indeed a zero sum game and it may not be sensible for all countries to be obsessed with building highly ranked world-class universities. According to Jalmi (2009), it is deemed unrealistic to aspire for world-class universities in most countries, particularly when there are numerous basic higher educational needs which need to be addressed. Altbach (2004) proposed that it may be better for countries to focus on building world-class departments, especially in fields that are most relevant to the needs of their local economy.
It is clear that global university rankings are becoming more popular and widely used as the benchmark to determine which universities are better; however, there is lack of studies devoted on examining how university rankings are related to the economic performance of countries. Therefore, the objective of this study is to fill this gap by investigating the impact of university rankings on GDP per capita and GDP growth. It is also imperative to search for literature pertaining to the factors which contribute to the country's performance in the 'university rankings game'.

Depken II and Mazonaite (2009) investigated the factors that contribute to the number of universities ranked in the QS Top 500 World Universities in 2008 and found that larger population, greater economic (and perhaps academic) freedom, industrialization and ethnic fractionalization all contribute to having a higher number of universities ranked in the Top 500 list. Li et al. (2009) found that the performance of universities in league tables is generally dependent upon four socioeconomic factors, namely, income, population size, research and development (R & D) spending as well as the national language.

Okorie (2013) showed that African countries with higher university performance generally performed better in the rankings of economic indicators such as Human Development Index (HDI). However, Okorie (2013) neglected the number of universities in Africa's Top 100 per capita basis. Marginson (2007) compared the countries' share of Top 100 and Top 500 research universities with their share of world GDP, but neglected to account for population effects.

Based on the findings presented above, it can be deduced that countries with higher income levels and larger populations are able to produce more WCUs in the ranking lists. Hence, a new simple regression model will be proposed in this paper in order to capture these features. Institutional factors such as 'freedom from corruption', 'respect for property rights', business 'freedom' and 'investment freedom' will be added into the model. The GDP growth as well as dependent variable is also considered in the model.

An evaluation of the existing literature relating to the economics of education from micro, macro and institutional perspectives is presented in the following section.

Economics of Education

At the micro level, human capital theory suggests that education is an investment that increases the productivity of workers, which increases the lifetime earnings of workers (Becker, 1964). Mincer (1974) included measures for on-the-job training and experience in the Mincer Equation. A number of studies confirmed the positive impact of education on an individual's earnings such as those by Card (1999), Amermuller et al.(2006), Cohn and Addison (1998), Schultz (1960), Becker (1967), Mincer (1958), Arrow (1973) and Spence (1974).
Temple (2001) and Harmon et al. (2003) concluded that there is strong evidence that private returns to education are unambiguously high. Temple (2001) estimated that the private rate of return to a year's extra schooling is typically between 5 and 15%.
Xiao (1999) found that pre-work formal education has a positive impact only on the initial salary at hiring and that firm-based on-the-job trainings increase salaries through an increase in productivity, based on a 1996 salary

survey of 1023 employees in Shenzhen, China. Mason et al. (2012) found that vocational skills have a positive impact on the average labour's productivity growth in six of the seven countries considered. Therefore, education can be more than just formal schooling.

There is a school of thought that suggests that education does not increase productivity; rather, it indicates the potential of productivity. Spence (1973) developed the Job Market Signaling Model which suggests that people attend universities to signal to the employers that they are more capable than others, even if the universities do not increase their productivity. Arrow (1973) developed a mathematical model which shows that higher education helps in identifying highly capable individuals and eliminating the less capable ones. Thurow (1975) suggested that firms can train well-educated workers at a lower cost. Harmon et al. (2000) showed that the education coefficient may not fully reflect the impact of education on productivity if it is correlated with unobserved characteristics such as ability that are also correlated with wages. Therefore, the education coefficient is more likely to reflect both the impact of education on productivity as well as the impact of the unobserved variable that is correlated with education.

However, Arrow (1973) did not believe that higher education primarily serves as a screening device due to the fact that professional schools and degrees in science subjects teach useful skills that are highly sought after in the market. However, this distinction is less clear for liberal arts courses. Sianesi and Van Reenen (2000) also concluded that education enhances productivity and is not merely a device for individuals to signal their abilities to employers.

From the authors' viewpoint, the most plausible answer is that both productivity and signalling effects occur concurrently and it is only a matter of which effect plays a more dominant role in determining the individual's returns to education.

Stevens and Weale (2003) argued that since education delivers economic benefits to individuals, it can be expected that countries with more education will generally grow better. Thus, it will be interesting to look at the returns to education from a macro level perspective.

The macroeconomic effects of education can be observed by looking into the way education can be measured. In general, education can be measured in terms of quantity and quality.

Cooray (2009) summarized two important points. Firstly, education quantity is measured by enrolment rates (Mankiw et al., 1992; Barro, 1991; Levine and Renelt, 1992), the average years of schooling (Hanushek and Woessmann, 2007; Krueger and Lindhal, 2001), adult literacy rate (Durlauf and Johnson, 1995; Romer, 1990), education spending (Baladacci et al., 2008). Second, there is a positive relationship between education quantity and economic growth, as discovered by Hanushek (1995), Gemmel (1996), Krueger and Lindahl (2001), Temple (2001). However, Benhabib and Spiegel (1994), Bils and Klenow (2000) and Prichett (2001) found a weak relationship between education quantity and economic growth. Barro (1991) concluded that 'poor countries tend to catch up with rich countries if the poor countries have high human capital per person (in relation to their level of per capita GDP)'.

Sianesi and Van Reenen (2000) found that the effects of primary and secondary schooling appear larger in magnitude and statistically more significant in less developed countries. In addition, primary and secondary skills are more related to growth in the poorest and intermediate developing countries, respectively, whereas tertiary skills are important for growth in OECD countries. Stevens and Weale (2003) also found that returns to education diminish with levels of development.

Increasing education quantity is a challenging task. Wils (2002) found that it took 55-100 years for 67% of the countries to rise from 10 to 90% adult literacy, whereas the remaining 23% progressed even slower. Anthony and Psacharopoulos (2011) stated that 'for a typical country, it takes 35-80 years to make a transition from 10% net primary enrolment to 90%'

(Wils 2003; Wils and O'Connor 2003a). Education transition follows an S-shaped curve due to the quantity of education that one can attain in terms of years of schooling (Meyer et al. 1992).

Sianesi and Van Reenen (2000) discovered a few important findings that are worth highlighting. First, neo-classical tradition argues that a one-off permanent increase in the human capital stock will cause a one-off increase in the economy's growth rate until the productivity per worker hour reaches its new (and permanently higher) steady-state level. New Growth theorists argue that the same one-off increase in human capital will cause a permanent increase in the growth rate. According to Dowrick (2002), there are debates over whether changes in educational attainment will ultimately affect either the long-term growth rate of the economy or the long-term levels of output. Second, there are reverse causality problems with education, which means that income growth may lead to an increased demand for education. It is believed that there is 'a bi-directional causality between human capital accumulation and economic growth'. Third, there are indirect benefits of human capital on growth by fostering the accumulation of productive inputs such as physical investment, technology and health. Fourth, their results suggest that education has a positive impact on growth.

With regards to education quality, Hanushek and Woessmann (2007) observed that one of the problems associated with measurements of education quantity is that such measurements implicitly assume that one year of education is of the same quality everywhere (e.g. Papua New Guinea and Japan).

Suggested measures of education quality include cost per student, number of library volumes per student, student-faculty ratios, faculty-administration ratios and student-support staff ratios (Conrad and Pratt, 1985). Dahlin (2002) observed that there are difficulties measuring the quality of education and that 'a low student-faculty ratio, for instance, says nothing about the faculty's ability to teach'. Hanushek (1996) found that the expenditure per pupil is not a good proxy for school quality.

Hanushek and Kim (1995), Barro (1999), Hanushek and Kimko (2000), as well as Hanushek and Woessmann (2007, 2010) used standardized test scores as a proxy for education quality. They found that there is a strong positive relationship between education quality and economic growth.

Hanushek and Woessmann (2007) discovered that education quantity is statistically significantly related to economic growth, neglecting education quality in their model. However, they found that the relationship between education quantity and economic growth is insignificant when education quality was included in the model. They measured education quality by using a simple average of mathematics and science scores over all international test scores.

Cooray (2009) measured education quality by survival rates, repetition rates, student/teacher ratios, schooling life expectancy and trained teachers in primary education, and found that education quantity has a positive and significant impact on economic growth when measured by enrolment ratios at primary, secondary and tertiary levels. It was also found that the interaction effect between government spending and education quality is significant for economic growth. However, there was no relationship between government spending and economic growth.

It shall be highlighted that measures of international standardized tests of cognitive skills could only at best, reflect education quality at the primary and secondary levels. It is therefore imperative to determine how higher education quality shall be measured. Past studies have shown that higher education plays an important role in promoting economic growth. For example, Sianesi and Van Reenen (2000) found that tertiary education is important for growth in OECD countries, while Bloom et al. (2006) found that higher education is important for growth in developing countries such as Sub-Saharan Africa. Wolff and Gittleman (1993) discovered that university enrolment rates are positively associated with labour productivity growth. Howitt (2013) suggested that university research can boost economic growth. Dowrick (2002) found that education and R & D are crucial for sustained economic growth.

Universities have a dual function, i.e. teaching and research. According to Liu and Cheng (2005), it is debatable whether the quality of universities can be measured by mere quantitative indicators. They argued that the only possible way to rank universities reliably is to rank their research performance based on internationally comparable data in which all parties can verify. They further stated that it will be impossible to measure and rank the quality of university education globally due to 'the huge differences of universities in the large variety of countries and the technical difficulties in obtaining internationally comparable data'.

Usher and Massimo (2007) found that there is an unequivocal agreement among different ranking systems on which universities are the best in a given country despite the huge differences in how various ranking systems rank the quality of an institution. They observed that the difference becomes more pronounced as one moves down the ordinal rankings, which may indicate that it is difficult to measure the majority of ordinary universities. There is abundant literature which shows that institution plays a complementary role for education in boosting economic growth, whereby a few key studies are highlighted below.

According to Bloom et al. (2006), it is less likely for fresh graduates to seek meaningful employment without proper macroeconomic management. A good example was provided by Patrions and Psacharopoulos (2001), who showed that Sri Lanka has a very poor economic performance even though the country has a highly educated labour force compared to its neighbours. This was due to bad political environment which dampens educated labour from realizing their full potential.

Prichett (2001) found that the impact of education varies widely across countries and offered three possible explanations. First, the institutional quality is extremely atrocious in some countries that education actually lowers economic growth, in which more educated pirates are produced. Second, the demand for educated labour remains the same and thus the marginal returns to education decline with an increase in the supply of educated labour. Third, education quality is extremely poor in some countries that additional years of schooling are useless and does not produce any human capital. Hence, it can be deduced that increasing both education quantity and quality is important.

Murphy et al. (1991) showed that talents will end up in non-productive rent-seeking activities if the country is conducive for corruption. They also carried out regression analysis which reveals that countries with a higher number of engineering students grow faster compared to countries with a higher number of law students. They primarily focused on rent-seeking and used college enrolment in law and engineering as a proxy for talents allocated to rent-seeking and entrepreneurship, respectively. Their findings showed that education in more technical subjects such as engineering has a more positive effect on growth. This was also supported by Lin (2004) who found that higher education, especially engineering and natural sciences, has a positive and significant effect on Taiwan's economic development.

In summary, it can be deduced that more (quantity) and better (quality) education is good for economic growth, given the right institutions. However, it is evident there is a lack of studies that address how the higher education sector affects the economic well-being of a country, and therefore one of the objectives of this study is to fill this gap.

Determinants of growth

It may be unwise to perform a simple regression model to determine the correlation between the GDP per capita/GDP growth and WCUs per capita without controlling other factors. Hence, this section is focused on the selection of factors which shall be controlled in the regression model.

This section is based on the findings of Petrakos et al. (2007), which provides an extensive review on the determinants of growth. Petrakos et al. (2007) also surveyed the determinants of growth from experts and these factors were identified as investment, human capital, innovation and R&D activities, economic policies, macroeconomic conditions, openness to trade, Foreign Direct Investment (FDI), institution, political environment, socio-cultural factors, geography and demographic trends. However, they highlighted that there is no unifying theory on the role of various factors that influence economic growth.

Petrakos et al. (2007) prepared questionnaires to explore the experts' opinions on the factors which affect economic dynamism. More than 500 questionnaires were distributed and the response rate was about 63%. The sample was evenly distributed between those working in the academia, (33%), as well as private sector (33%) and public sector (30%). Most respondents (37%) completed a doctorate degree, whereas 35% possessed a postgraduate degree. The value of this survey was based on the characteristics of the respondents. The sample group consisted of people with an informed opinion in the academia, public and private sectors, and the results were quite consistent with the mainstream literature.

The factors which were regarded as most influential differ slightly between developing and developed countries. The top three actors identified for developed countries are innovation and R&D, high quality of the human capital, and specialization in knowledge and capitalintensive sectors. In contrast, the top three factors identified for developing countries are stable political environment, significant foreign direct investments and secure formal institutions (property rights, as well as legal, tax and finance systems).

Since this study is focused on both developed and developing countries, the above mentioned factors need to be taken account as they are deemed relevant for both developed and developing countries. It is also assumed that the university ranking factor captures the high quality of human capital, innovation and R&D, specialization in knowledge and capital intensive sectors. The factors excluded are stable political environment, foreign direct investments and secure formal institutions, which can be categorized as institutional factors. This is consistent with the conclusion of the previous section (i.e. Economics of Education).

Hence, 'Property Rights', 'Freedom from Corruption', 'Business Freedom' and 'Investment Freedom' are selected as the relevant proxies for institutional factors, and are taken from the Index of Economic Freedom 2013 compiled by the Heritage Foundation.

Research methodology

Formulation of WCUs per capita

In this study, the term 'World Class Universities per capita' or 'WCUs per capita' is created to describe the relative abundance of world-class universities. The 'WCUs per capita' is given by that the number of world-class universities in a particular country divided by its respective population. It will be misleading to merely look at the absolute number of worldclass universities. For example, even though China is only a developing country, the country boasts 28 universities that are among the Top 500 in ARWU 2013 due to its large population size. However, many small but high-income economies do not have any of their universities listed in the ranking lists. In this regard, the effect of population on university ranking performance needs to be considered.

The formula for WCUs per capita is given by:

$$\text{WCUs per capita} = \frac{\text{Number of World Class Universities}}{\text{Population}} \quad (1)$$

The only quantitative measures of world-class universities known to date are the various global university rankings that have proliferated since 2003, such as ARWU, NTU Ranking and QS World University Ranking. University rankings are therefore the proxies for worldclass universities.

When university rankings are incorporated into WCUs per capita, the formula is represented by:

$$\text{Top N per capita} = \frac{\text{Number of Universities in Top N}}{\text{Millions of Population}} \quad (2)$$

where N refers to the number of universities in the numerical ranking order.

If the universities listed among the Top 500 are world-class universities, the formula is given by:

$$\text{Top 500 per capita} = \frac{\text{Number of Universities in Top 500}}{\text{Millions of Population}} \quad (3)$$

If it is desired that the universities among the Top 100 deserve the world-class status, the formula is then:

$$\text{Top 100 per capita} = \frac{\text{Number of Universities in Top 100}}{\text{Millions of Population}} \quad (4)$$

In a similar manner, the Top 200 per capita, Top 300 per capita, Top 400 per capita can be calculated using Equation 2.

Design

In this study, ARWU is chosen as the benchmark for World-Class Universities due to the fact that ARWU is regarded as the most objective and comprehensive indicator of university quality (Li et al., 2009; Marginson, 2007; Taylor and Braddock, 2007; Hazelkorn, 2007). In contrast, the THES-QS ranking relies heavily on peer reviews, which are heavily criticized for being too subjective and leading to high volatility of ranking results (Li et al., 2009).

The GDP per capita and GDP growth are the dependent variables since they are one of the common measures of economic well-being.

The correlation matrix between GDP per capita and Top N per capita is shown in Table 1. It can be seen that the GDP per capita has the highest correlation with the Top 500 per capita.

Table 1: Correlation matrix between GDP per capita and Top N per capita

GDP per capita	Top 500 per capita	Top 400 per capita	Top 300 per capita	Top 200 per capita	Top 100 per capita	

1.0000	0.7264	0.6889	0.6325	0.55000	0.4395	GDP per capita
	1.0000	0.9672	0.9187	0.8392	0.8738	Top 500 per capita
		1.0000	0.9484	0.9072	0.9025	Top 400 per capita
			1.0000	0.9285	0.8835	Top 300 per capita
				1.0000	0.8959	Top 200 per capita
					1.0000	Top 100 per capita

Since there is a high correlation among the Top N per capita, the Top N per capita can only be added into the regression model one at a time. Multicollinearity issues will arise if more than one Top N per capita is included.

The Top 100 per capita and Top 500 per capita are used as the independent variables in the regression model. It shall be noted that the Top 500 per capita gives the largest sample of countries since there are 500 universities in the Top 500. The Top 100 per capita is used to determine if there are variations in the level of significance when a more elite and exclusive group of universities is considered.

The correlation matrix between the log GDP per capita and log Top N per capita is presented in Table 2. It can be observed that the log GDP per capita has the highest correlation with the log Top 400 per capita and the correlation appears to be higher for the logarithm of these variables. Regression analysis is carried out using the logarithm of these variables to determine if there are improvements in the model.

Table 2: Correlation matrix between log GDP per capita and log Top N per capita

Log GDP per capita	Log Top 500 per capita	Log Top 400 per capita	Log Top 300 per capita	Log Top 200 per capita	Log Top 100 per capita	
1.0000	0.8630	0.9090	0.8726	0.8708	0.6839	Log GDP per capita
	1.0000	0.9889	0.9486	0.9133	0.9253	Log Top 500 per capita
		1.0000	0.9675	0.9500	0.9355	Log Top 400 per capita
			1.0000	0.9690	0.9161	Log Top 300 per capita
				1.0000	0.9323	Log Top 200 per capita

					1.0000	Log Top 100 per capita

The correlation between the log GDP per capita and institutional factors considered in this study is shown in Table 3. It can be seen that the highest correlation exist between 'freedom from corruption' and the log GDP per capita, followed by 'property rights', 'business freedom' and 'investment freedom'. This observation is consistent with the regression results, which will be described in the Results section.

Table 3: Correlation between log GDP per capita and institutional factors

Log GDP per capita	
0.7860	Freedom from Corruption
0.7268	Property Rights
0.6780	Business Freedom
0.6226	Investment Freedom

Procedure

Simple regression analysis is first carried out using the GDP per capita and Top N per capita as follows:

GDP per capita = $\beta_0 + \beta_1$ Top 100 per capita
GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita

Following this, logarithm is applied to the variables to determine if the model is improved.

Log GDP per capita = $\beta_0 + \beta_1$ Log Top 100 per capita
Log GDP per capita = $\beta_0 + \beta_1$ Log Top 500 per capita

Both models are then compared with the GDP growth since one of the objectives of this study is to determine whether a country's university performance affects its GDP growth. In this analysis, the GDP growth is used as the dependent variable rather than the GDP per capita, as shown below.
GDP growth = $\beta_0 + \beta_1$ Top 100 per capita
GDP growth = $\beta_0 + \beta_1$ Top 500 per capita

It is found that both Top 100 per capita and Top 500 per capita do not have any significant effects on GDP growth, which will be described in the following section.

The final step involves testing the robustness of the first model. The institutional factors shown in Table 3 (i.e. 'freedom from corruption', 'property rights', 'business freedom' and 'investment freedom') are controlled and included in the final regression model, as follows:

GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita + β_2 clean (i.e. freedom from corruption)
GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita + β_2 property rights
GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita + β_2 businessfreedom

GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita + β_2 investmentfreedom

GDP per capita = $\beta_0 + \beta_1$ Top 500 per capita + β_2 clean + β_3 property rights + β_4 businessfreedom + β_5 investmentfreedom

Data Sets

The university ranking data are taken from the ARWU database for year 2013. The year 2013 is chosen because it represents the most recent data. In addition, universities in Greater China (i.e. mainland China, Hong Kong, Taiwan and Macau) are categorized under China due to political reasons prior to year 2013. It is only last year that the ARWU provides the breakdown of these universities as Mainland China, Hong Kong and Taiwan, as shown in the Appendix. The data reveals that none of the universities in Macau are listed in the Top 500. More importantly, ARWU publishes a table on 'Statistics by Country', which shows the number of universities in the Top 20, Top 100, Top 200, Top 300, Top 400 and Top 500 of each country, which greatly facilitates data collection.

These statistics are used compute the data for the number of universities listed in the Top 100, Top 200, Top 300, Top 400, and Top 500 based on country. This data are then divided by its respective population. The Top 20 is omitted because only three countries (i.e. the United States, United Kingdom and Switzerland) are represented in the Top 20.

The population data are extracted from the 2012 World Population Data Sheet produced by the Population Reference Bureau in order to determine the Top 100 per capita, Top 200 per capita, Top 300 per capita, Top 400 per capita and Top 500 per capita. These variables (WCUs per capita) are not divided directly with its population; rather, millions of population is used as the denominator. Theoretically, the population data should not be retrieved from year 2012. However, the population data for year 2013 is unavailable at the date of writing.

The data on GDP per capita and GDP growth are taken from the World Bank for year 2012 as the data for year 2013 is also unavailable at the date of writing. The GDP per capita and its logarithm are both used as the dependent variable in the regression models outlined above. Even though the GDP growth can be used as the dependent variable in the regression models, its logarithm cannot be used due to the fact that several countries exhibit negative growth rates during that year.

Institutional factors (i.e. 'freedom from corruption', 'property rights', 'business freedom', and 'investment freedom') are taken from the Index of Economic Freedom 2013 supplied by the Heritage Foundation. These data are given on a scale of 0 – 100. A detailed definition of each institutional factor is given in the Appendix.

Although there is a possibility that the data above may be theoretically and conceptually wrong due to the difference in year (2012 and 2013), it is assumed that one year of difference is negligible and will not affect the results. It is expected that the results will be similar, regardless whether the data are based on year 2012 or 2013.

Results

Group 1: GDP per capita

The regression models for the first group of data are presented in Table 4 and 5, in which the dependent variable is GDP per capita and log GDP per capita, respectively. The results show that the coefficients are positive for both cases, which is consistent with the hypothesis that higher education has a positive impact on economic well-being.

The outliers for Model 1 are found to be Norway (0.800, 99170), Switzerland (0.055, 46707), Australia (0.864, 67304), Canada (2.875, 78881) and Sweden (1.392, 33433). Switzerland, Norway and Australia over-performed in GDP per capita relative to their Top 500 per capita, whereas Sweden and Canada under-performed in GDP per capita relative to their Top 500 per capita.

The outliers for Model 2 are Norway (-0.22, 11.5), Switzerland (-2.90, 10.75), Egypt (-4.41, 8.04), and Malaysia (-1.96, 8.58). Switzerland and Norway over-performed in GDP per capita relative to their Top 500 per capita, whereas Egypt and Malaysia under-performed in GDP per capita relative to their Top 500 per capita.

Table 4: Model 1: OLS, using observations 1-45
Dependent variable: GDP per capita

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
constant	17398.9	2960.6	5.8768	<0.00001 ***
Top 500 per capita	29469.7	4251.92	6.9309	<0.00001 ***

R-squared 0.527668 Adjusted R-squared 0.516683

Table 5: Model 2: OLS, using observations 1-45
Dependent variable: Log GDP per capita

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
constant	10.7846	0.0964747	111.7863	<0.00001 ***
Log Top 500 per capita	0.440994	0.0393603	11.2040	<0.00001 ***

R-squared 0.744853 Adjusted R-squared 0.738919

The actual and fitted GDP per capita as well as actual and fitted log GDP per capita are shown in Figure 1 and 2, respectively. From Figure 1, the GDP per capita and Top 500 per capita are used as the dependent and independent variable, respectively. It can be observed that most of the points are clustered near the origin.

From Figure 2, the log GDP per capita and log Top 500 per capita is the dependent and independent variable, respectively. In contrast to Figure 1, it can be seen that the points are more dispersed around the fitted line, which indicates that Model 2 is a better model.

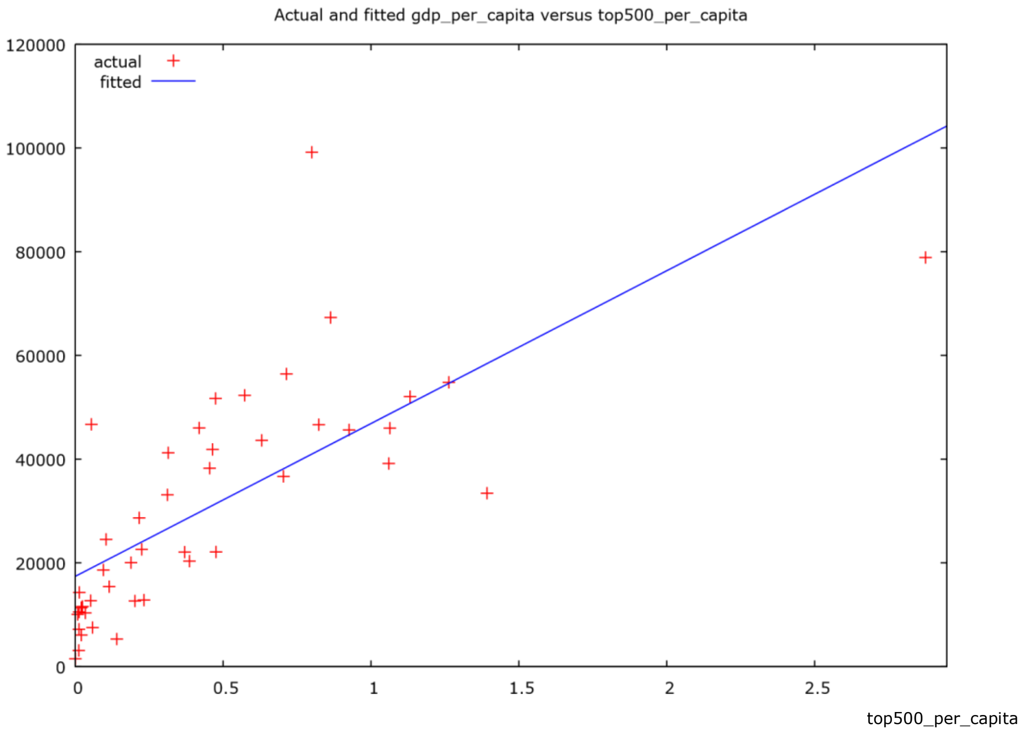

Figure 1: GDP capita versus Top 500 per capita

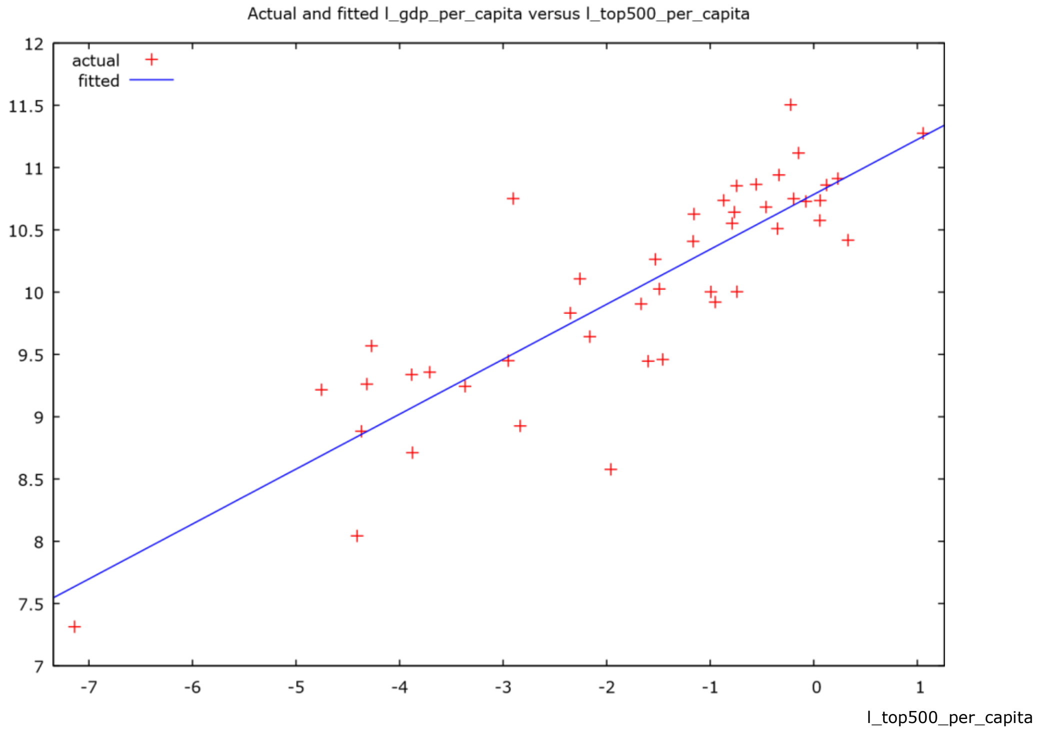

Figure 2: Log GDP per capita versus Top 500 per capita

The result for Model 3 is shown in Table 6, in which the log Top 100 per capita is used as the independent variable. It can be observed that the level of significance decreases when the Top 100 per capita is used as the independent variable in replacement of the log Top 500 per capita. The t-ratio decreases from 11.2040 to 3.5070, which implies that having fundamental tertiary education (Top 500) is more important than elite education (Top 100).

Table 6: Model 3: OLS, using observations 1-16
Dependent variable: Log GDP per capita

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
constant	11.2842	0.168538	66.9537	<0.00001	***
Log Top 100 per capita	0.256425	0.073119	3.5070	0.00349	***

R-squared 0.467655 Adjusted R-squared 0.429630

Group 2: GDP growth

The results for Model 4 and 5 are shown in Table 7 and 8, respectively. The dependent variable for both regression models is the GDP growth in year 2012, whereas the independent variable is Top 100 per capita and Top 500 per capita for Model 4 and 5, respectively. It can be observed that the correlation coefficients are negative, which indicate that the emerging economies (with poorer university research performance) grow faster compared to developed nations (with highly ranked world-class universities). These findings are consistent with the trend in recent years. The t-ratio is found to be less than 1.0, which indicates that the results are insignificant. Hence, there is an insignificant relationship between the Top N per capita and GDP growth.

Since the statistical results above show that Top 100 per capita and Top 500 per capita have a positive and significant effect on the GDP per capita but have an insignificant effect on GDP growth, it can be deduced that that world-class universities appear to be the consumption of luxury goods for rich countries rather than an investment for future growth. This is not true however, as it is known that having higher education quality and quantity is generally good for the economy. It is likely that world class universities and WCUs per capita have lagged effects on GDP growth. If there are global university rankings prior to year 2003, a timeseries regression analysis can be carried out to investigate the existence of these lagged effects of WCUs and their mechanism.

Table 7: Model 4: OLS, using observations 1-16
Dependent variable: GDP growth 2012

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
constant	1.68245	0.706768	2.3805	0.03204	**
Top 100 per capita	-2.22667	2.9791	-0.7474	0.46717	

R-squared 0.038373 Adjusted R-squared -0.030315

Table 8: Model 5: OLS, using observations 1-45
Dependent variable: GDP growth 2012

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
constant	1.23335	0.524091	2.3533	0.02325	**
Top 500 per capita	-0.319579	0.752684	-0.4246	0.67326	

R-squared 0.004175 Adjusted R-squared -0.018984

Group 3: Addition of institutional factors

A robustness test is carried out on the logarithm of the first group of variables, in which institutional factors are added. The results are summarized in Table 9 and it can be observed that the log Top 500 per capita is significant for all cases when only one of the institutional factors is controlled in the regression models. Among the institutional factors, it is found that only 'freedom from corruption' and 'property rights' appear significant when they are included in the regression models. None of the institutional factors is significant when they are all included in the models. The results show that the log Top 500 per capita passes the robustness test, which indicates that the GDP per capita is greatly influenced by the Top 500 per capita in terms of percentage.

Table 9: Model 10: OLS, using observations 1-45
Dependent variable: l_gdp_per_capita

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	9.83992	0.340382	28.9085	<0.00001	***
l_top500_per_capita	0.320422	0.0555253	5.7707	<0.00001	***
clean	0.012116	0.00421315	2.8758	0.00630	***

R-squared 0.786828 Adjusted R-squared 0.776677

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	10.0755	0.339246	29.6998	<0.00001	***
l_top500_per_capita	0.357967	0.0537269	6.6627	<0.00001	***
property	0.00848161	0.00390426	2.1724	0.03552	**

R-squared 0.770627 Adjusted R-squared 0.759704

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	10.0499	0.589641	17.0441	<0.00001	***
l_top500_per_capita	0.391729	0.055229	7.0928	<0.00001	***
businessfreedom	0.00826739	0.00654721	1.2627	0.21365	

R-squared 0.754185 Adjusted R-squared 0.742480

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	10.3445	0.364274	28.3975	<0.00001	***
l_top500_per_capita	0.400667	0.0506569	7.9094	<0.00001	***
investmentfreedom	0.0054897	0.00438398	1.2522	0.21742	

R-squared 0.754036 Adjusted R-squared 0.742323

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	9.83042	0.59838	16.4284	<0.00001	***
l_top500_per_capita	0.318984	0.0616475	5.1743	<0.00001	***
clean	0.0148174	0.00869877	1.7034	0.09645	*
property	-0.0034927	0.00929687	-0.3757	0.70919	
businessfreedom	-0.000191771	0.00728053	-0.0263	0.97912	
investmentfreedom	0.00134603	0.00616931	0.2182	0.82843	

R-squared 0.787608 Adjusted R-squared 0.760378

Discussion

The results show that even though there is a strong and significant relationship between WCUs per capita and GDP per capita, there is an insignificant relationship between WCUs per capita and GDP growth. This suggests that education is more of a consumption rather than an investment to increase income at both micro and macro levels. It may be possible that education is a consumption of luxury goods for the minority of the population even though it is known that higher education quality and quantity is generally better for the economy. Conversely, it is likely that WCUs per capita has lagged effects on GDP growth due to the fact that the development of human capital may take some time to materialize. A time-series regression analysis is not carried out in this study since university rankings are unavailable prior to year 2003. It is recommended that future studies are focused on time-series regression analysis in order to investigate the lagged effects of WCUs per capita on GDP growth.

Even though it is found that there is a significant relationship between WCUs per capita and GDP per capita, the causality between these variables remains unclear. It cannot be ascertained whether more and better higher education increases income level (at both individual and national levels) or the other way round. It is likely that both effects reinforce each other, which means that people generally place a high value and invest more on tertiary education with an increase in income levels, which in turn makes their children richer, and the process continues in a never-ending cycle. There may also be diminishing returns to higher education, which means that additional units of higher education will more likely become a 'consumption' rather than an 'investment' after reaching a certain threshold. For instance, people may opt to further their studies to the postgraduate level for the educational prestige and experience even though the return on investment for such degrees is usually less than that for bachelor degrees. Another interesting observation is that the relationship between WCUs per capita and GDP per capita becomes more significant when the ranking list is expanded from the Top 100 to Top 500. It can be inferred that it is more pertinent for a country to focus on developing a good number of decent world-class universities (Top 500), rather than being obsessed with building one or a few more elite world-class universities (Top 100) in order to attain higher GDP per capita. It shall be emphasized that university ranking is a zero sum game and there can only be 500 universities listed in the Top 500. It is not sufficient for universities to merely improve on an ongoing basis in order to attain a relatively higher GDP per capita; rather, they must outperform universities in other nations. It is also very likely that all forms of poverty can be eliminated if the poverty thresholds remain the same after 100 years. However, inequality will nevertheless persist. A world in which all countries are equally rich is unlikely and represents a highly idealistic case. In reality, there are wealthy and poor nations. Nations with better world-class universities are more likely to be at the forefront of technological change and thus enjoying a higher GDP per capita. The optimistic side is that all countries will eventually grow and have better living standards in the long run.

There is no 'magic formula' to create a world class university (Salmi, 2009) and it may be unrealistic for all countries to build world-class universities. Each country should choose a strategy that best suits its national circumstances. For most countries, addressing fundamental tertiary educational needs is far more beneficial rather than being obsessed with building one or two world-class universities, which will benefit only a minority of the population.

In addition, world-class universities are not the sole factor that influences economic performance. For example, the first regression model predicts that China and India has a GDP per capita of USD 18,009.94 and USD 17,442.30, respectively, based on their Top 500 per capita. This indicates that China and India are high-income economies based on the World Bank's standards. However, in reality, these countries have a GDP per capita of USD 6,071 and USD 1,501 respectively, which is far below the predicted GDP per capita. Thus, it is evident that higher education is not the main barrier of economic performance and other factors such as legislation may have inhibited their economic performance. It is possible that these countries will achieve the predicted GDP per capita in the future based on their WCUs per capita. Similar analyses can be applied to other countries and further investigation need to be carried out on this new analytical framework. In this study, several institutional factors are extracted from the Index of Economic Freedom supplied by the Heritage Foundation. The results show that 'freedom from corruption' and 'property rights' are significant when either one of these institutional factors is added into the regression model, whereas 'business freedom' and 'investment freedom' are found to be insignificant. The 'log Top 500 per capita' may explain some of the institutional factors such as 'business freedom' and 'investment freedom'.

It shall be highlighted that the ARWU only measures the universities' research performance, in which a number of indicators such as highly cited researchers and the number of papers published in Nature and Science are measured. The ARWU ranking system does not reflect teaching quality, and the Quality of Education is measured by the number of alumni winning Nobel Prizes and Field Medals. The EURA 2011 report also highlights that ARWU favours universities in which the core competencies are natural sciences, medicine and engineering, and ARWU is therefore a good guideline for students intending to pursue courses in these fields. ARWU is clearly a good proxy for university research quality, and is thus biased towards postgraduates and neglects undergraduate teaching. This is particularly important since the majority university graduates join the workforce based on their bachelor degrees. It shall be noted that only students who are inclined to join the academia or embark on a research career will further their studies to the postgraduate level. If there is no positive correlation between university research and university teaching, then it can be stated that university R & D and innovation explains the variations in GDP per capita.

Conclusion

The following conclusions are drawn based on the findings of this paper.

1. WCUs per capita is strongly correlated to a country's GDP per capita. However, the WCUs per capita has an insignificant effect on GDP growth.

2. ‘Freedom from corruption’ is the most significant institutional factor when institutional factor is added into the regression model, followed by ‘property rights’, ‘business freedom’ and ‘investment freedom’.

There are a number of issues which are unaddressed in this paper which are worthy of investigation in future work and are listed as follows:

1. In future studies, it will be interesting to examine how universities relate to a country’s economic performance. It shall be noted that universities may excel in either teaching or research, or a combination of both fields. In this study, it is clear that the ARWU university ranking is only a good indicator of a university’s research performance.

2. Based on the definition given by the World Bank, there are 43 high-income economies without WCUs such as Brunei, Luxembourg, Macau, Qatar and United Arab Emirates. This study is focused on a number of developing countries such as China, India, Malaysia, Iran and Egypt. Hence, it will be interesting to investigate how such developing countries manage to achieve the status of world-class universities whereas a number of high-income economies have none of their universities listed among the Top 500. The question here is: ‘Why these high-income nations perform well economically even though none of their universities are accorded the status of world-class university?’

It may be possible that some of these high-income economies are very small countries which primarily specialize in a few niche areas such as oil export, casinos and tax haven.

3. It shall be noted that many poor developing countries such as those in Africa do not have any universities listed in the Top 500. If the universities in these countries are listed in the university ranking lists, then regression analysis can be performed to determine if there is a correlation between GDP per capita and GDP growth with WCUs per capita. If there is a significant correlation, this indicates that there should be more policies focused on tertiary education in these developing countries.

4. It is generally more challenging for authors whose native language is not English to publish in top journals (Altbach 2011), and it is known that publications in languages other than English are read by fewer researchers (EUA Report on Rankings 2013). In fact, the rankings based on research performance are biased towards universities whose native language is English and it is recommended that a special weight should be allotted for papers published in other languages (Liu and Cheng, 2005). However, it shall be noted that the regression models used in this study do not include English as the dummy variable due to technical issues in classifying countries as English-speaking and nonEnglish speaking. For instance, HEC Paris taught some courses in English in a Frenchspeaking country. Hence, future studies can be devoted on examining issues such as language bias.

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Appendix

ARWU methodology

Indicators and Weights for ARWU

Criteria	Indicator	Code	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Research Output	Papers published in Nature and Science*	N&S	20%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	20%
Per Capita Performance	Per capita academic performance of an institution	PCP	10%
Total			100%

* For institutions specialized in humanities and social sciences such as London School of Economics, N&S is not considered, and the weight of N&S is relocated to other indicators.

Data source: http://www.shanghairanking.com/ARWU-Methodology-2013.html

Data Sources

Indicator	Data Source
Nobel laureates	http://nobelprize.org/
Fields Medals	http://www.mathunion.org/index.php?id=prizewinners
Highly cited researchers	http://www.highlycited.com/
Papers published in Nature and Science	hhttp://www.webofknowledge.com/
Articles indexed in Science Citation Index-Expanded and Social Science Citation Index	http://www.webofknowledge.com/
Others	Number of academic staff. Data is obtained from national agencies such as National Ministry of Education, National Bureau of Statistics, National Association of Universities and Colleges, National Rector's Conference.

Data source: http://www.shanghairanking.com/ARWU-Methodology-2013.html

Definition of Indicators

Indicator	Definition
Alumni	The total number of the alumni of an institution winning Nobel Prizes and Fields Medals. Alumni are defined as those who obtain bachelor, Master's or doctoral degrees from the institution. Different weights are set according to the periods of obtaining degrees. The weight is 100% for alumni obtaining degrees in 2001-2010, 90% for alumni obtaining degrees in 19912000, 80% for alumni obtaining degrees in 1981-1990, and so on, and finally 10% for alumni obtaining degrees in 1911-1920. If a person obtains more than one degrees from an institution, the institution is considered once only.
Award	The total number of the staff of an institution winning Nobel Prizes in Physics, Chemistry, Medicine and Economics and Fields Medal in Mathematics. Staff is defined as those who work at an institution at the time of winning the prize. Different weights are set according to the periods of winning the prizes. The weight is 100% for winners after 2011, 90% for winners in 2001-2010, 80% for winners in 1991-2000, 70% for winners in 1981-1990, and so on, and finally 10% for winners in 19211930. If a winner is affiliated with more than one institution, each institution is assigned the reciprocal of the number of institutions. For Nobel prizes, if a prize is shared by more than one person, weights are set for winners according to their proportion of the prize.
HiCi	The number of Highly Cited Researchers in 21 subject categories. These individuals are the most cited within each category. If a Highly Cited Researcher has two or more affiliations, he/she was asked to estimate his/her weights (or number of weeks) for each affiliation. More than 2/3 of those multi-affiliated Highly Cited Researchers provided such estimations and their affiliations receive the weights accordingly. For those who did not answer, their first affiliation is given a weight of 84% (average weight of the first affiliations for those who replied) and the rest affiliations share the remaining 16% equally.
N&S	The number of papers published in Nature and Science between 2008 and 2012. To distinguish the order of author affiliation, a weight of 100% is assigned for corresponding author affiliation, 50% for first author affiliation (second author affiliation if the first author affiliation is the same as corresponding author affiliation), 25% for the next author affiliation, and 10% for other author affiliations. Only publications of 'Article' and 'Proceedings Paper' types are considered.
PUB	Total number of papers indexed in Science Citation Index-Expanded and Social Science Citation Index in 2012. Only publications of 'Article' and 'Proceedings Paper' types are considered. When calculating the total number of papers of an institution, a special weight of two was introduced for papers indexed in Social Science Citation Index.
PCP	The weighted scores of the above five indicators divided by the number of full-time equivalent academic staff. If the number of academic staff for institutions of a country cannot be obtained, the weighted scores of the above five indicators is used. For ARWU 2013, the numbers of full-time equivalent academic staff are obtained for institutions in USA, UK, France, Canada, Japan, Italy, China, Australia, Netherlands, Sweden, Switzerland, Belgium, South Korea, Czech, Slovenia, New Zealand etc.

Data source: http://www.shanghairanking.com/ARWU-Methodology-2013.html

Statistics by Region

Region	Top 20	Top 100	Top 200	Top 300	Top 400	Top 500
Americas	17	56	95	127	156	182
Europe	3	33	75	126	164	200
Asia/Oceania	—	11	30	46	78	114
Africas	—	—	—	1	2	4
Total	20	100	200	300	400	500

Statistics by Country

Statistics of Shanghai Ranking (ARWU)

Country	Top20	Top100	Top200	Top300	Top400	Top500
United States	17	52	85	108	131	149
United Kingdom	2	9	19	29	33	37
Switzerland	1	4	6	7	7	7
Australia	—	5	7	9	16	19
Germany	—	4	14	23	30	38
France	—	4	8	16	18	20
Canada	—	4	7	16	18	23
Japan	—	3	9	10	15	20
Netherlands	—	3	8	10	12	12
Sweden	—	3	5	8	10	11
Israel	—	3	4	4	6	7
Denmark	—	2	3	4	4	4
Belgium	—	1	4	6	7	7
Norway	—	1	1	3	3	4
Finland	—	1	1	1	3	5
Russia	—	1	1	1	2	2
China	—	—	7	13	26	42
Italy	—	—	4	9	12	19
South Korea	—	—	1	4	7	11
Austria	—	—	1	3	3	7

Saudi Arabia	—	—	1	2	3	4
Singapore	—	—	1	2	2	2
Brazil	—	—	1	1	5	6
Argentina	—	—	1	1	1	1
Mexico	—	—	1	1	1	1
Spain	—	—	—	4	8	10
New Zealand	—	—	—	2	2	5
Ireland	—	—	—	1	3	3
South Africa	—	—	—	1	2	3
Czech	—	—	—	1	1	1
Portugal	—	—	—	—	2	4
Greece	—	—	—	—	2	2
Poland	—	—	—	—	2	2
Hungary	—	—	—	—	1	2
India	—	—	—	—	1	1
Serbia	—	—	—	—	1	1
Chile	—	—	—	—	—	2
Croatia	—	—	—	—	—	1
Egypt	—	—	—	—	—	1
Iran	—	—	—	—	—	1
Malaysia	—	—	—	—	—	1

Slovenia	—	—	—	—	—	1
Turkey	—	—	—	—	—	1
Total	20	100	200	300	400	500

The breakdown of China into Taiwan, Hong Kong and Mainland China.

Due to political reasons, the "China" in the statistics above includes Mainland China, Taiwan and Hong Kong, and we need to break it down into the rankings for Mainland China, China-Taiwan and China-Hong Kong.

Academic Ranking of World Universities 2013

China-Taiwan

Country Rank	Institution	World Rank
1	National Taiwan University	101-150
2	National Tsing Hua University	201-300
3-5	Chang Gung University	301-400
3-5	National Cheng Kung University	301-400
3-5	National Chiao Tung University	301-400
6-9	China Medical University	401-500
6-9	National Central University	401-500
6-9	National Sun Yat-Sen University	401-500
6-9	National Yang Ming University	401-500

* Institutions within the same rank range are listed alphabetically.

Data source: http://www.shanghairanking.com/World-University-Rankings-2013/China-tw.html

Academic Ranking of World Universities 2013

China-Hong Kong

Country Rank	Institution	World Rank
1	The Chinese University of Hong Kong	151-200
2-3	The Hong Kong University of Science and Technology	201-300
2-3	The University of Hong Kong	201-300
4-5	City University of Hong Kong	301-400
4-5	The Hong Kong Polytechnic University	301-400

* Institutions within the same rank range are listed alphabetically.

Data source: http://www.shanghairanking.com/World-University-Rankings-2013/China-hk.html Academic Ranking of World Universities 2013

China

Country Rank	Institution	World Rank
1-5	Fudan University	151-200
1-5	Peking University	151-200
1-5	Shanghai Jiao Tong University	151-200
1-5	Tsinghua University	151-200
1-5	Zhejiang University	151-200

6-8	Nanjing University	201-300
6-8	Sun Yat-sen University	201-300
6-8	University of Science and Technology of China	201-300
9-16	Beijing Normal University	301-400
9-16	China Agricultural University	301-400
9-16	Harbin Institute of Technology	301-400
9-16	Huazhong University of Science and Technology	301-400
9-16	Jilin University	301-400
9-16	Shandong University	301-400
9-16	Sichuan University	301-400
9-16	Xian Jiao Tong University	301-400
17-28	Beihang University	401-500
17-28	Central South University	401-500
17-28	Dalian University of Technology	401-500
17-28	Lanzhou University	401-500
17-28	Nankai University	401-500

17-28	Peking Union Medical College	401-500
17-28	South China University of Technology	401-500
17-28	Southeast University	401-500
17-28	Tianjin University	401-500
17-28	Tongji University	401-500
17-28	Wuhan University	401-500
17-28	Xiamen University	401-500

* Institutions within the same rank range are listed alphabetically.

Data source: http://www.shanghairanking.com/World-University-Rankings-2013/China.html

Definition of Institutional Factors

Freedom from Corruption

Corruption erodes economic freedom by introducing insecurity and uncertainty into economic relationships. The score for this component is derived primarily from Transparency International's Corruption Perceptions Index (CPI) for 2011, which measures the level of corruption in 183 countries. The CPI is based on a 10-point scale in which a score of 10 indicates very little corruption and a score of 0 indicates a very corrupt government. In scoring freedom from corruption, the *Index* converts the raw CPI data to a scale of 0 to 100 by multiplying the CPI score by 10.
For example, if a country's raw CPI data score is 5.5, its overall freedom from corruption score is 55. For countries that are not covered in the CPI, the freedom from corruption score is determined by using the qualitative information from internationally recognized and reliable sources.[1] This procedure considers the extent to which corruption prevails in a country. The higher the level of corruption, the lower the level of overall economic freedom and the lower a country's score.
Source: http://www.heritage.org/index/freedom-from-corruption

Property Rights

The property rights component is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. It measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts.

The more certain the legal protection of property, the higher a country's score; similarly, the greater the chances of government expropriation of property, the lower a country's score. Countries that fall between two categories may receive an intermediate score.
Each country is graded according to the following criteria:

- **100**—Private property is guaranteed by the government. The court system enforces contracts efficiently and quickly. The justice system punishes those who unlawfully confiscate private property. There is no corruption or expropriation.
- **90**—Private property is guaranteed by the government. The court system enforces contracts efficiently. The justice system punishes those who unlawfully confiscate private property. Corruption is nearly nonexistent, and expropriation is highly unlikely.
- **80**—Private property is guaranteed by the government. The court system enforces contracts efficiently but with some delays. Corruption is minimal, and expropriation is highly unlikely.
- **70**—Private property is guaranteed by the government. The court system is subject to delays and is lax in enforcing contracts. Corruption is possible but rare, and expropriation is unlikely.
- **60**—Enforcement of property rights is lax and subject to delays. Corruption is possible but rare, and the judiciary may be influenced by other branches of government. Expropriation is unlikely.
- **50**—The court system is inefficient and subject to delays. Corruption may be present, and the judiciary may be influenced by other branches of government. Expropriation is possible but rare.
- **40**—The court system is highly inefficient, and delays are so long that they deter the use of the court system. Corruption is present, and the judiciary is influenced by other branches of government. Expropriation is possible. **30**—Property ownership is weakly protected. The court system is highly inefficient. Corruption is extensive, and the judiciary is strongly influenced by other branches of government. Expropriation is possible.
- **20**—Private property is weakly protected. The court system is so inefficient and corrupt that outside settlement and arbitration is the norm. Property rights are difficult to enforce. Judicial corruption is extensive. Expropriation is common.
- **10**—Private property is rarely protected, and almost all property belongs to the state. The country is in such chaos (for example, because of ongoing war) that protection of property is almost impossible to enforce. The judiciary is so corrupt that property is not protected effectively. Expropriation is common.
- **0**—Private property is outlawed, and all property belongs to the state. People do not have the right to sue others and do not have access to the courts. Corruption is endemic.

Source: http://www.heritage.org/index/property-rights

Business Freedom

Business freedom is an overall indicator of the efficiency of government regulation of business. The quantitative score is derived from an array of measurements of the difficulty of starting, operating, and closing a business. The business freedom score for each country is a number between 0 and 100, with 100 equaling the freest business environment. The score is based on 10 factors, all weighted equally, using data from the World Bank's Doing Business study:

- Starting a business—procedures (number);
- Starting a business—time (days);
- Starting a business—cost (% of income per capita);
- Starting a business—minimum capital (% of income per capita);
- Obtaining a license—procedures (number);[1]

- Obtaining a license—time (days);
- Obtaining a license—cost (% of income per capita);
- Closing a business—time (years);
- Closing a business—cost (% of estate); and
- Closing a business—recovery rate (cents on the dollar).[2]

Each of these raw factors is converted to a scale of 0 to 100, after which the average of the converted values is computed. The result represents the country's business freedom score. For example, even if a country requires the highest number of procedures for starting a business, which yields a score of zero in that factor, it could still receive a score as high as 90 based on scores in the other nine factors. Canada, for instance, receives scores of 100 in nine of these 10 factors, but the 14 licensing procedures required by the government equate to a score of 64.5 for that factor.

Each factor is converted to a scale of 0 to 100 using the following equation:

$\text{Factor Score}_i = 50\ \text{factor}_{average}/\text{factor}_i$

which is based on the ratio of the country data for each factor relative to the world average, multiplied by 50. For example, on average worldwide, it takes 18 procedures to get necessary licenses. Canada's 14 licensing procedures are a factor value better than the average, resulting in a ratio of 1.29. That ratio multiplied by 50 equals the final factor score of 64.5. For the six countries that are not covered by the World Bank's Doing Business report, business freedom is scored by analyzing business regulations based on qualitative information from reliable and internationally recognized sources.[3]

Source: http://www.heritage.org/index/business-freedom

Investment Freedom

In an economically free country, there would be no constraints on the flow of investment capital. Individuals and firms would be allowed to move their resources into and out of specific activities, both internally and across the country's borders, without restriction. Such an ideal country would receive a score of 100 on the investment freedom component of the *Index of Economic Freedom*.

In practice, most countries have a variety of restrictions on investment. Some have different rules for foreign and domestic investment; some restrict access to foreign exchange; some impose restrictions on payments, transfers, and capital transactions; in some, certain industries are closed to foreign investment. Labor regulations, corruption, red tape, weak infrastructure, and political and security conditions can also affect the freedom that investors have in a market.

The *Index* evaluates a variety of restrictions that are typically imposed on investment. Points, as indicated below, are deducted from the ideal score of 100 for each of the restrictions found in a country's investment regime. It is not necessary for a government to impose all of the listed restrictions at the maximum level to effectively eliminate investment freedom. Those few governments that impose so many restrictions that they total more than 100 points in deductions have had their scores set at zero.

Investment restrictions:

National treatment of foreign investment

- No national treatment, prescreening 25 points deducted
- Some national treatment, some prescreening 15 points deducted
- Some national treatment or prescreening 5 points deducted

Foreign investment code

- No transparency and burdensome bureaucracy 20 points deducted
- Inefficient policy implementation and bureaucracy 10 points deducted

• Some investment laws and practices non-transparent or inefficiently implemented 5 points deducted

Restrictions on land ownership

• All real estate purchases restricted 15 points deducted
• No foreign purchases of real estate 10 points deducted
• Some restrictions on purchases of real estate 5 points deducted

Sectoral investment restrictions

• Multiple sectors restricted 20 points deducted
• Few sectors restricted 10 points deducted
• One or two sectors restricted 5 points deducted

Expropriation of investments without fair compensation

• Common with no legal recourse 25 points deducted
• Common with some legal recourse 15 points deducted
• Uncommon but occurs 5 points deducted

Foreign exchange controls

• No access by foreigners or residents 25 points deducted
• Access available but heavily restricted 15 points deducted
• Access available with few restrictions 5 points deducted

Capital controls

• No repatriation of profits; all transactions require government approval 25 points deducted
• Inward and outward capital movements require approval and face some restrictions 15 points deducted
• Most transfers approved with some restrictions 5 points deducted

Up to an additional 20 points may be deducted for security problems, a lack of basic investment infrastructure, or other government policies that indirectly burden the investment process and limit investment freedom.

Source: http://www.heritage.org/index/investment-freedom