DETECTING FOR CONVERGENCE TRENDS AMONG CHINESE UNIVERSITIES IN TERMS OF ACADEMIC PERFORMANCE

Maria ADAMAKOU
PhD Candidate, Department of Planning and Regional Development, University of Thessaly
madamakou@uth.gr

Dimitris KALLIORAS
Professor, Department of Planning and Regional Development, University of Thessaly
dkallior@uth.gr

Abstract

Under the conditions of the rapid market liberalization process that China has been experiencing, questions of spatial cohesion – and thus of convergence and divergence – become increasingly salient. This is so as the elimination of spatial imbalances is both a pre-condition and a core objective of the reforms aiming at market liberalization. The paper aims at detecting trends of convergence among Chinese universities in terms of academic performance. Taking into consideration that within the knowledge-based economy universities are emerging growth determinants, the topic of the paper is extremely important. This is so as the possible prevalence of divergence trends may indicate that the growth impact of Chinese universities is not space neutral. The empirical analysis of the paper covers the period 2018/19-2022/23, utilizes data obtained from the URAP database, and employs the methodological approach of gaps convergence clubs. The findings of the paper provide valuable insight into both theory and policy.

Keywords: Chinese universities, academic performance, gaps convergence clubs
JEL classification: C21, O43, O47

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1. Introduction

Within the knowledge-based economy, universities are emerging growth determinants. In addition to their traditional role in teaching and basic research, universities are expected to engage in regional development processes facilitating the creation of knowledge capital through the diffusion of knowledge spillovers (Lendel 2010, Chen et al. 2014, Trippl et al. 2015, Adamakou et al. 2021b, Adamakou et al. 2021c, Kallioras et al. 2021, Fernández Del Río 2022 inter alia). It is the helix framework (Etzkowitz and Leydesdorff 2000, Carayannis and Campell 2009, Carayannis et al. 2012, Höglund and Linton 2018, inter alia) that forms an ever-growing body of literature that aptly describes university–industry–government–public–environment interactions. Thus, the question regarding the impact of universities on spatial disparities is extremely meaningful. Indirectly but clearly, the possible prevalence of divergence trends among universities, in terms of academic performance, indicates that the growth impact of universities is not space neutral.

The paper aims at detecting trends of convergence among Chinese universities in terms of academic performance. Under the conditions of the rapid market liberalization process that China has been experiencing, transitioning, since the late 1970s, from a state-dominated planned socialist economy to a mixed economy (Naughton 2007, Schaffar and Dimou 2010, Kroeber 2016, Weber 2021 inter alia), questions of spatial cohesion – and thus of convergence and divergence – become increasingly salient. This is so as the elimination of spatial imbalances is both a pre-condition and a core objective of the reforms aiming at market liberalization (Wei 2002, Fan 2006, Fan et al. 2011, Li et al. 2013 inter alia). Towards the latter, the higher education system has been an essential part (Xiong et al. 2022). With the increase in the income level, the demand for higher education in China has increased remarkably (Li et al. 2014, Yue 2015). Having achieved the goals of massification and popularization, the transformation from scale expansion to quality improvement is, now, the dominant goal for higher education in China (Li 2016, Xi 2022).

The current section of the paper is introductory. The next section presents the data. The third section presents the methodology. The penultimate section performs the empirical analysis. The last section of the paper offers the conclusions.

2. Data

URAP (University Ranking by Academic Performance) has developed a ranking system for world universities based on academic performance indicators that reflect the quality and the quantity of their scholarly publications (Table 1). The URAP ranking system provides scores of academic performances and not just, merely, the ranking of each university. Compared to the most widely-read university ranking systems (i.e., QS (Quacquarelli Symonds), THE (Times Higher Education), ARWU (Academic Ranking of World Universities)), URAP covers considerably more universities. Even though URAP excludes teaching indicators – and this is a major point of criticism (Rauhvargers 2011, 2013 and 2014) – it enjoys a high level of acceptance (Nethal and Harrison, 2014, Adamakou et al. 2021a).

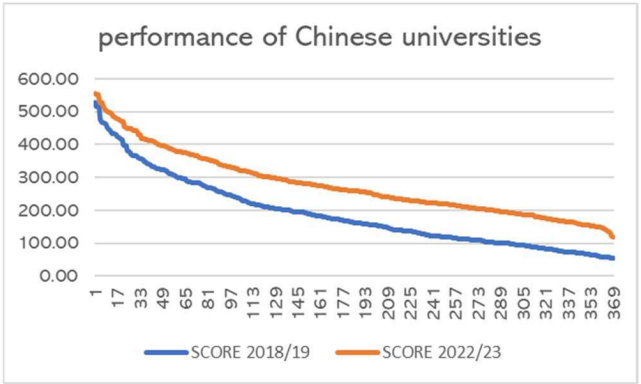
Table 5. The URAP ranking system

Indicator	Explanation	Weight
Article	articles published in journals that are listed within the first, second and third quartiles in terms of their journal impact factor	21%
Citation	the total number of citations received in the past four years for the articles published in the past four years in journals that are listed within the first, second and third quartiles in terms of their journal impact factor	21%
Total Document	all scholarly output of the institutions, published during the past four years	10%
Article Impact Total	the scientific productivity corrected by the institution's normalized citations per publication with respect to the world citations per publications in 23 subject areas in the past two years	18%
Citation Impact Total	the research impact corrected by the institution's normalized citations per publication with respect to the world citations per publication in 23 subject areas in the past two years	15%
International Collaboration	the total number of articles published in collaboration with foreign universities	15%

Sources: URAP / Authors' elaboration

The empirical analysis of the paper covers the period 2018/19-2022/23 and utilizes data obtained from the URAP database. URAP provides data for 498 Chinese universities located in mainland China (i.e., the territory under direct administration of the Chinese government). However, 369 universities (the names are available upon request) are included in the analysis since they have data for both periods under consideration. Comparing the academic performances between the period 2018/19 and the period 2022/23, it is noteworthy that: (a) the scores for all universities are moving upwards (Image 1), (b) the standard deviation of the scores is decreasing (Table 2), and (c) the universities that possess the lowest places in the ranking (i.e., bottom-10 universities) during the period 2018/19 exhibit higher increases compared to the universities that correspondingly possess the highest places (i.e., top-10 universities) (Table 3 and Table 4).

Image 6. Academic performance of Chinese universities, periods 2018/19 and 2022/23



Sources: URAP / Authors' elaboration

Table 2. Academic performance of Chinese universities, periods 2018/19 and 2022/23

	performance 2018/19	performance 2022/23
min	55.70	118.86
max	526.05	556.14
mean	189.71	277.15
st. dev.	106.14	95.97

Sources: URAP / Authors' elaboration

Table 3. Academic performance change of the top-10 universities, period 2018/19 and time interval 2018/19-2022/23

universities (top-10)	score 2018/19	Δ score (%) 2018/19-2022/23
1. Tsinghua University	526.05	5.09
2. Peking University	516.15	3.97
3. Shanghai Jiao Tong University	515.57	7.87
4. Zhejiang University	511.04	7.82
5. Fudan University	476.62	7.94
6. Huazhong University of Science & Technology	466.78	13.00
7. Sun Yat Sen University	466.21	12.93
8. University of Science & Technology of China	462.16	8.61
9. Nanjing University	460.19	5.08
10. Xi'an Jiaotong University	449.83	11.12

Sources: URAP / Authors' elaboration

Table 4. Academic performance change of the bottom-10 Chinese universities, period 2018/19 and time interval 2018/19-2022/23

universities (bottom-10)	score 2018/19	Δ score (%) 2018/19-2022/23
360. Shanghai University of Sport	58.03	188.71
361. Jining University	57.63	106.25
362. Jiujiang University	57.35	168.63
363. Gannan Medical University	56.51	173.70
364. Shenyang Jianzhu University	56.43	183.18
365. Shaanxi University of Technology	56.42	169.53
366. Tianjin Agricultural University	56.30	138.69
367. Binzhou University	55.84	148.26
368. Binzhou University	55.71	119.91
369. Yanan University	55.70	250.41

Sources: URAP / Authors' elaboration

3. Methodology

The paper employs the methodological approach of gaps convergence clubs (Chatterji 1992, Chatterji and Dewhurst 1996), in order to detect for convergence trends, in terms of academic performance, among Chinese universities. The methodological approach of gaps convergence clubs transcends the rationale of linearity, pointing out that it is quite natural to expect that groups of entities are converging but that these groups are themselves diverging from each other. Broadly speaking, this means that convergence and divergence trends may coexist, although in different proportions and at different strengths (Petrakos et al. 2011). Convergence clubs are related with a wide variety of empirical models that allow for multiple regimes (Azariadis and Drazen 1990, Durlauf 1993, Galor 1996, Quah 1996 *inter alia*).

The methodological approach of gaps convergence clubs requires the identification of a "leading" entity. The latter may be considered as the entity with the highest figure in terms of the variable under consideration among the entities considered. The gap is the quotient between the figure of the variable under consideration that belongs to the "leading" entity and the figures of the variable under consideration that belong to each of the entities considered (including the "leading" entity). The approach of gaps convergence clubs relates the gap, in terms of the variable under consideration, at one date with the corresponding gap at an earlier date, including further powers of the latter (Equation 1). The reference point of the approach of gaps convergence clubs is the pre-assumption of specific polynomial functions and the consequent classification of the entities considered into convergence clubs on the basis of the corresponding pre-assumed equilibria (Artelaris et al. 2010, Artelaris et al. 2012, Anagnostou et al. 2016, Kallioras et al. 2017, Ekonomou and Kallioras 2020). Apparently, considering that considerable multicollinearity makes difficult the choice of the best parsimonious

estimation, the final specification of the equation is made under the rule of dropping out the statistically insignificant coefficients. When more than one equation have statistically significant coefficients, the specification with the lowest Akaike Information Criterion (AIC) (Akaike 1974) figure is chosen.

$$\ln\left(Y_{l,f}/Y_{e,f}\right) = \sum_{p=1}^{n} \gamma_p \left[\ln\left(Y_{l,b}/Y_{e,b}\right)\right]^p + u_e \quad (1)$$

b = base (i.e., initial) year, f = final year, e = entities considered ("leading" entity is included), l = "leading" entity, Y = variable under consideration, γ = coefficient, p = power, n = highest power, u = disturbance term

The interpretation of the estimated (i.e., the selected) equation necessitates the utilization of the graphic representation of the $y = x$ equation (i.e., the 45°-straight-line) as a benchmark. Such a benchmark eases the interpretation evincing the entities that, on average, converge to the "leading" one as well as the entities that, on average, diverge from the "leading" one. Particularly, convergence to the "leading" entity is detected when, on average, the gap in the final year is lower than the corresponding gap in the initial year (i.e., the line of the estimated equation is below the line of the benchmark equation, in the first quarter). Divergence from the "leading" entity is detected, otherwise.

4. Empirical analysis

The econometric investigation for the emergence of convergence clubs among Chinese universities, in terms of academic performance, indicates that the second-power equation is the best parsimonious equation (Table 5). The dependent variable of the model is the gap in the period 2022/23 and the independent variable is the corresponding gap in the period 2018/19. The "leading" university is Shanghai Jiao Tong University. This is the university with the highest academic performance in the period 2022/23 (for the period 2018/19, the university with the highest academic performance is Tsinghua University). The overall explanatory power of the model (Adjusted R-squared) is extremely satisfactory (0.92) and the independent variable of the model is statistically significant (at the 1% level of significance) in both the first and the second power. The corresponding first-power, third-power, and fourth-power equations have been rejected (see Table A1, Table A2, and Table A3 in the Appendix). The third-power and the fourth-power equations have been rejected because they have statistically non-significant terms (i.e., in both equations the independent variable is statistically significant in the first power only). The first-power equation has been rejected, even though the independent variable is statistically significant, because compared to the corresponding second-power equation the AIC figure is lower.

Table 5. Convergence clubs among Chinese universities, time interval 2018/19-2022/23

Dependent Variable: GAPSCORE2022/23
Included observations: 369

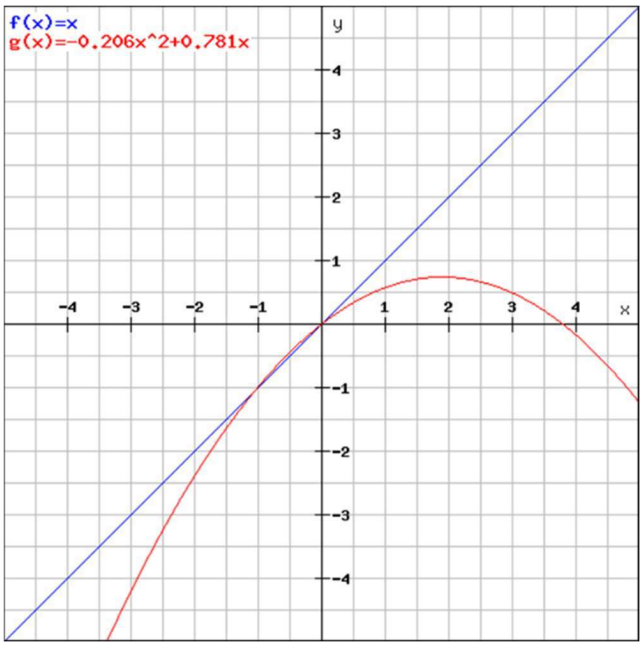
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAPSCORE2018/19	0.781341	0.015853	49.28599	0.0000
GAPSCORE2018/19^2	-0.205558	0.022291	-9.221425	0.0000

R-squared	0.910877	Mean dependent var	0.327398
Adjusted R-squared	0.910635	S.D. dependent var	0.146614
S.E. of regression	0.043829	Akaike info criterion	-3.411637
Sum squared resid	0.705000	Schwarz criterion	-3.390440
Log likelihood	631.4470	Hannan-Quinn criter.	-3.403216
Durbin-Watson stat	1.707285		

Sources: URAP / Authors' elaboration

The graphic visualization of the estimated equation and the benchmark equation (i.e., y=x) (Image 2) eases the interpretation of the results. Evidently, in the 1st quadrant (i.e., the upper-right quadrant) the line of the estimated function is below the line of the benchmark. Indeed, solving the corresponding system of equations, it comes that the solutions are (-1.063, -1.063) and (0.000, 0.000). Thus, the only solution in the 1st quadrant is (0.000, 0.000). This indicates that, on average, all Chinese universities converge to the "leading" university (i.e., Shanghai Jiao Tong University) and *inter se*. In other words, all Chinese universities form one convergence club. Moreover, the pace of convergence is incremental. This is so as the estimated function is concave down, with a local maximum at (2.114, 2.114), and all Chinese universities fall into the ascending part of equation (i.e., the highest initial gap is 0.967; Yanan University).

Image 2. Convergence clubs among Chinese universities, graphic visualization, time interval 2018/19-2022/23



Sources: URAP / Authors' elaboration

5. Conclusions

The question regarding the impact of universities on spatial disparities is extremely meaningful, considering that, within the knowledge-based economy, universities are emerging growth determinants. Indirectly but clearly, the possible prevalence of divergence trends among universities, in terms of academic performance, indicates that the growth impact of universities is not space neutral. The paper conducts an empirical analysis for convergence trends among Chinese universities, in terms of academic performance. Under the conditions of the rapid market liberalization process that China has been experiencing, questions of spatial cohesion become increasingly salient. This is so as the elimination of spatial imbalances is both a pre-condition and a core objective of the reforms aiming at market liberalization. The empirical analysis of the paper covers the time interval 2018/19 – 2022/23, utilizes data obtained from URAP, and employs the methodological approach of gap convergence clubs.

The findings of the paper indicate that all Chinese universities form one convergence club, with incremental convergence pace, and provide valuable insight into both theory and policy. In terms of theory, the findings of the paper demonstrate that public policies can generate self-correcting mechanisms for spatial imbalances, irrespective of the ability of the markets to do so. Thus, convergence is (also) a policy-led process that does not take place in an institution-free environment. In terms of policy, the findings of the paper demonstrate the importance of policy interventions focusing on alleviating institutional imbalances across Chinese

educational space. Up to now, it seems that that a set of well-targeted and carefully-designed tertiary education policies have been implementing by the Chinese government.

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