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Frank Bickenbach and Wan-Hsin Liu

Abstract: Over the past decade the scale of higher education in China has expanded substantially. Regional development policies attempted to make use of the scale expansion as a tool to reduce the inequality of higher education among different regions with different development levels through providing the poor regions preferential treatment and support in this regard. This paper analyses a provincial dataset (1997-2008), aiming to provide comprehensive quantitative evidence for the development of inequality of higher education opportunities across provinces in China over the period of the scale expansion, taking different sizes and economic development levels of provinces into account. Results show that the regional inequality of higher education relative to provinces' different population sizes clearly decreased over the research period. Accompanying the reduction in overall inequality across provinces, the inequality between the poor and the rich regions actually increased over the same period. However, the increase was realised in favour of the poor region. The empirical results are consistent with the policy orientation of reforming the higher education system and of promoting regional development in China over the past decade.

Keywords: higher education, regional inequality, China, Theil index

JEL classification: C43. I23, I28, R53, R58

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1 Introduction

China's strong economic growth over the past decades has attracted a great deal of attention worldwide. The open door policy since the late 1970s has induced the inflow of large foreign direct investments (FDI) especially in labour-intensive industries, aiming to profit from China's large resources of low-cost labour-force. As a result, the labour-intensive industries have developed rapidly over the reform period. The rapidly developing labour-intensive industries are well integrated into the global production networks and are responsible for the low value-added part of the production activities of the global value chain in particular. Against the background of intensified market competition and a rising challenge from increasing labour costs, the Chinese government has gradually revised its economics policy towards more innovation and upgrading promotion. A highly qualified labour-force is crucial for progressing in innovation and upgrading.

To improve the average education level of the Chinese labour-force and to increase the provision of highly-qualified workers for companies in China, the Chinese government has already made some progress in reforming its higher education system. Above all, over the past decade the scale of higher education in China has expanded substantially. Local governments and universities have been granted more autonomy in managing university-related affairs. Local governments have been encouraged to take over the operation of some universities managed centrally before and to found new universities, taking into account the local needs for promoting societal and economic development. The central government has restricted itself to focus on a much smaller number of role-model universities in China than before.[1] Though students from provinces other than the provinces where the role-model universities are located also have opportunities through the national university entrance exam to study at these universities, the home-biased pre-determined new student quotas of such universities restrict the cross-provincial mobility of students.[2] Over the reform process the local and regional features of the higher education system in China have become more pronounced (CCCPC (1985), (1993), (1999); NEC (1995); PRC (1999); SCPRC (1994)).

[1] In 1998 about one third of all universities were centrally governed (MOE(a) (1999)). By contrast, in 2008 only about 5% of all universities were governed by central ministries and agencies (NBSC(a) (2009)).

[2] Though the entrance exam is called the "national university entrance exam", different provinces may use different exam sheets for the same subject. Moreover, students taking the exam compete directly with other students from the same province but not with those from other provinces. The distribution of students to universities is based on the students' score-based positions among all exam participants from the same province and their preference for majors and universities. However, the possibility of students to get access to universities, especially to non-local ones, strongly depends, in addition, on the pre-determined province-specific new student quotas of the individual universities (e.g. Chen (2004); He (2007)).

The scale expansion in higher education has transformed the higher education system in China from the one emphasising elite education to the one promoting mass higher education, aiming to enhance the average educational level and qualification of the Chinese labour-force. The policy decision for the scale expansion in higher education (CCCPC (1999)) concerned all 31 provinces in mainland China[3]. However, due to regional economic considerations, there has been a particular emphasis by the central government on expanding higher education in economically backward provinces. Over the last decade, regional economic policy determined by the central government has increasingly gained importance. Its focus is on promoting economic development and/or industrial structural change in the provinces in Western, Central and North-Eastern part of China [4]. Compared to the provinces of the Coastal or Eastern region[5], the economic development in these three regions is clearly lagging behind. Taking into account the idiosyncratic characteristics of the three regions, different regional policy decisions have been announced by the central government. Reforming and/or expanding the local and regional higher education systems has been emphasised with different weights in these region-specific policy decisions. According to the corresponding policy decisions, the expansion and further improvement of the higher education system in particularly poor provinces (Western region) should obtain preferential treatment and support from the central government. The aim is to support the convergence of the shares of the population with higher education in these provinces to the corresponding national average share (GOSCPRC (2001), (2002); OWDSCPRC (2002); SCPRC (2000), (2004)). For the North-Eastern and Central regions, which are more developed than the Western region, the regional economic policy plans also mentioned the importance of higher education. The promotion of higher education and in particular the increase of quantitative higher education opportunities was less strongly emphasised for these regions, however, and no preferential treatment, comparable to that for the Western region, was explicitly provided (CCCPC (2003), (2006); GOCCCPC (2004); NDRC et al. (2007)).

Have these policy objectives and related decisions actually lead to a more equal distribution of higher education opportunities among regions and provinces in China and have poor provinces actually benefited the most from the expansion of the higher education system?

[3] More specifically, the provincial level division consists of 22 provinces, 5 autonomous regions and 4 municipalities. For simplicity we will refer to all of these units as provinces.

[4] The Western region comprises 12 provinces (Chongqing, Gansu, Guangxi, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang, Yunnan), the Central region 6 provinces (Anhui, Henan, Hubei, Hunan, Jiangxi, Shanxi) and the North-Eastern region comprises 3 provinces (Heilongjiang, Jilin, Liaoning).

[5]The Coastal (Eastern) region comprises 10 provinces: Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Shandong, Shanghai, Tianjin, Zhejiang.

This paper aims to answer these questions by providing statistical evidence on the development of the inequality of higher education opportunities across provinces and regionally and economically defined groups of provinces. In order to do so, it employs a provincial panel dataset for the period from 1997 to 2008 to calculate a series of generalised Theil inequality indices with different regional weights and references, which allow us to highlight various aspects of the issue of the evolution of the inequality of higher education opportunities across (groups of) Chinese provinces.[6]

The remainder of the paper is organised as follows. Section 2 briefly describes some key quantitative features of the (development of) the higher education system in China and of inter-regional differences in economic development. Section 3 introduces the generalised Theil index of inequality (Section 3.1), which is then used to measure the inequality in the distribution of higher education opportunities across provinces (and groups of provinces) taking provincial heterogeneity in size and structural development into account and to describe the evolution of this inequality over time (Section 3.2). Section 4 summarises the empirical results and discusses them in light of the Chinese government's regional economic policy priorities.

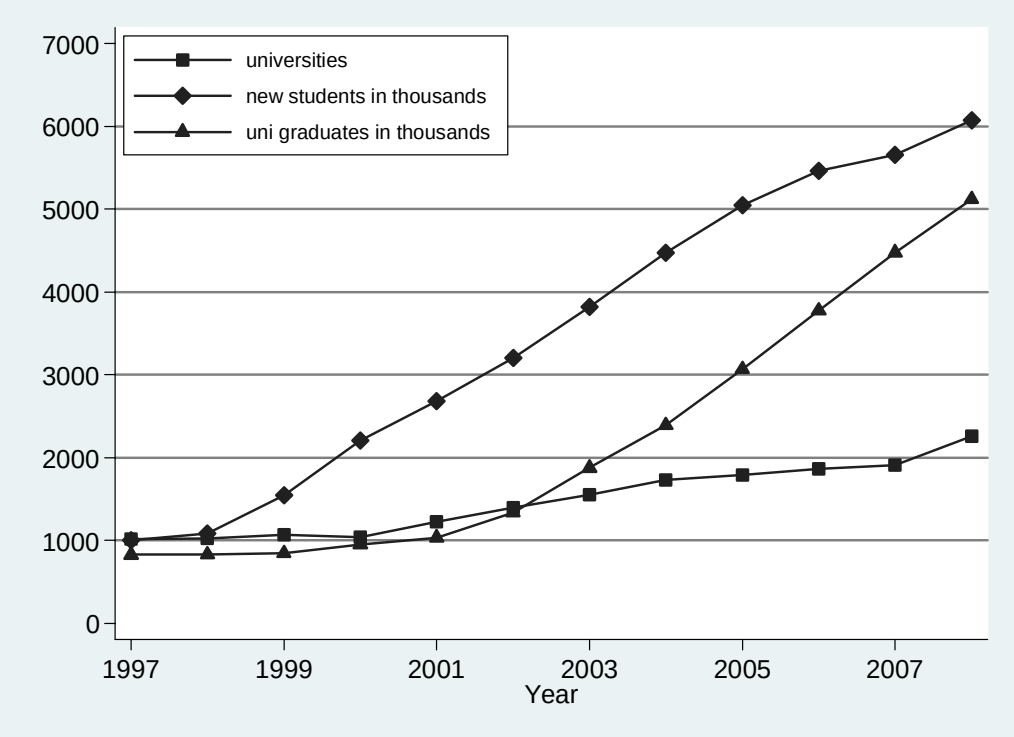
2 The higher education system and regional economic development: an overview

Prior to the policies' decision for a large scale expansion of higher education opportunities in 1999, the higher education system in China was designed to support higher education of a rather small elite. There had already been some increase over time in the number of universities and the number of students from 1978 (the year of the revival of the national university entrance exam) to 1998. That increase was rather modest, however, compared to the increase during the period since 1999 in which the higher education system has been gradually transformed to promote mass higher education. While it took about twenty years for the number of universities (or *regular higher education institutions*) to increase from 598 universities in 1978 to 1,022 universities in 1998 (Li and Xing (2010)), it just took another decade to more than double the number of universities to 2,263 in 2008. As regards the increase in the number of students, the difference in growth rate was even larger (Figure 1). While the number of newly enrolled students increased by about 5% annually from 0.4 million students in 1978 to 1.08 million in 1998 (Li and Xing (2010)), it increased by more than 43% (to reach 1.55 million) in just one year from 1998 to 1999. Over the period from

[6] The provincial dataset was collected from the Educational Statistics Yearbook of China (MOE(b) (various years)) and from the China Statistical Yearbook (NBSC(a) (various years)).

1999 to 2008, the number of newly enrolled students continued to increase at very high annual growth rate of an average 19%. As a result of the large scale expansion of the university system, there were about 20.21 million university students in total in 2008 compared to just 3.41 million in 1998. In 2008, more than five million students graduated from university, more than six times the corresponding number in 1998. In total, about 6.7% of the Chinese population older than 6 (incl.) years of age were highly educated (with university degree or higher) in 2008, compared to 2.8% in 1998.[7]

Figure 1: Number of universities and new students (in thousands) in China, 1997-2008



Sources: MOE(b) (various years).

Classifying the 31 provinces of China into four regions (according to the regional economic policy classification), the Coastal (Eastern)[8] region is the region with the highest level of development of both the economy and the higher education system. The Coastal region, which accounts for roughly 10% of the geographic area of mainland China, consists of 10 provinces that together account for about 37% of the total Chinese population (in 2008). It was the pioneer region of the Chinese economic reform and is China's economically the most advanced region, with its Gross Domestic Product (GDP) per capita roughly 1.5 times the

[7] These shares were calculated from official statistics that were obtained through the annual National Sample Survey on Population Changes which is based on a sample of roughly 1‰ of total population.
[8] See Footnote 5 in Section 1.

national average (25,012 RMB[9]) in 2008. The region hosted the largest share of universities (40% of universities in 2008 up from 38% in 1998) and the greatest share of new students was enrolled at the universities in the Coastal region (40% in 2008 down from 43% in 1998).

By contrast, the Western region, which consists of 12 provinces[10] covering more than seven times the area of the Coastal region, is the economically least developed Chinese region, Its GDP per capita accounted for about 64 % of the national level (or about 43% of the level of the Coastal region) in 2008. While the Western region's population size was about three fourth of that of the Coastal region in 2008 (about 85% in 1998), the number of newly enrolled students in the West was only about half of that of the Coastal region. More precisely, only about 24% of all universities were located in the West in 2008 (also 1998) and its share of newly enrolled students was only 23% in 2008 (up from 21% in 1998).

In sum, over the past decade of higher educational reform there has been a massive expansion of the scale of the university system. While the number of universities more than doubled in just one decade the number of newly enrolled students grew even sixfold and the number of university graduates followed with the corresponding three to four years delay. A first brief comparison of some aggregate figures for the most and the least advanced regions suggests that these massive changes may have come along with surprisingly small changes in the regional distribution of universities and of university students among the Chinese regions. Whether this first impression is supported or refuted by a more systematic data analysis and whether it can possibly be generalised to the distribution of higher education opportunities across individual provinces and (across and within) alternative grouping of provinces will be the subject of the next section.

3 Inequality of higher education opportunities across provinces

3.1 Measuring inequality

In this paper we aim to provide quantitative evidence on the inequality, or the concentration, of higher education opportunities across the 31 Chinese provinces and its development over time. In addition, we aim to trace the overall (changes in) inequality to (changes in) the corresponding inequality within and between meaningfully defined subgroups of provinces. To be able to do so we have to apply appropriate measures of inequality. In the economics

[9] Using the average exchange rate (PBC (2008)), this was roughly equal to US$3,600.
[10] See Footnote 4 in Section 1.

literature a large number of alternative inequality measures have been defined and applied to various economic questions. Among the most frequently applied inequality measures are the coefficient of variation, the Gini coefficient, the Atkinson class of measures, and the generalised entropy (GE) class of measures. As the GE class of inequality measures satisfies a number of criteria useful for our analysis, and as all inequality measures that satisfy these properties are ordinally-equivalent transformations of GE measures (Cowell (2011): Section 3.4), we choose GE measures for our analysis. One of the criteria that will prove particularly important for our analysis is the decomposability of the measure.[11] Decomposability implies that, for any mutually exclusive set of subgroups of provinces (which may be defined on the basis of geographic (regional) or economic criteria), the total inequality across provinces can be meaningfully decomposed into the inequality *within* these subgroups and the inequality *between* these subgroups.

The GE class of inequality measures is generally defined as:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{I}\sum_{i=1}^{I}\left(\frac{X_i}{\frac{1}{I}\sum_i X_i}\right)^{\alpha} - 1\right], \qquad (1)$$

where I is the number of observations (in our case provinces), X_i (i=1, …, I) is the realisation of the variable of interest (here the supply of higher education opportunities) for observation i, and $\overline{X}$ is the arithmetic mean of the variable of interest over all observations, $\overline{X} = (1/I)(\sum_i X_i)$. The parameter α, which can take any real value, represents the GE-weight given to different observation-specific deviations from the mean. For lower values of α, the GE measure is more sensitive to changes at the lower tail of the distribution (of X), and for higher values of α, the measure is more sensitive to changes at the upper tail of the distribution (Cowell and Flachaire (2007)). For any α, the value of GE(α) is equal to zero in the case of complete equality, $X_i = \overline{X}$ for all i, otherwise it is strictly positive, with higher values of GE(α) representing higher levels of inequality (or concentration) in the distribution of X across observations i.

The most frequently used values of α are 0, 1, and 2, where the formulae for GE(0) and GE(1) can be derived from formula (1) using l'Hopital's rule. For α=0, we thereby get

[11] The other criteria satisfied by the GE class of inequality measures are the "weak principle of transfer", "scale independence", and the "principle of population" (for a discussion see Cowell (2011): Section 3.4).

$$\text{GE(0)} = \frac{1}{I}\sum_{i=1}^{I}\ln\left(\frac{\overline{X}}{X_i}\right), \text{ a measure also known as the mean log deviation.} \qquad (2)$$

For α=1, we get

$$\text{GE(1)} = \frac{1}{I}\sum_{i=1}^{I}\frac{X_i}{\overline{X}}\ln\left(\frac{X_i}{\overline{X}}\right), \text{ a measure also known as the Theil index.}^{12} \qquad (3)$$

For our empirical analysis of the inequality of higher education opportunities across Chinese provinces in the next section, we will mainly use the Theil index (GE(1)). To test the robustness of our results and conclusions we also calculate the corresponding GE(0) and GE(2) measures. However, rather than confining our analysis to the use of GE measures as defined by (1), and in particular the Theil index as defined by (3), we will make use of a slight generalisation of the class of GE measures that has been introduced by Bickenbach and Bode (2008). This more generalised form of GE measures will allow us to better take into account the heterogeneity of provinces in terms of their population sizes or other relevant structural variables, while investigating the inequality in higher education in China.

More concretely, following Bickenbach and Bode (2008) we define our generalised, weighted relative Theil index as follows:[13]

$$GE^{wr}(1) = T^{wr} = \sum_{i=1}^{I} w_i \frac{\frac{X_i}{\Pi_i}}{\sum_i w_i \frac{X_i}{\Pi_i}} \ln\left(\frac{\frac{X_i}{\Pi_i}}{\sum_i w_i \frac{X_i}{\Pi_i}}\right), \qquad (4)$$

where I and X_i are defined as before, and where $\prod_i$ is referred to as the reference for observation i and w_i (with $\sum_i w_i = 1$) is referred to as the weight of observation i. For the special case of $\prod_i = 1$ and $w_i = 1/I$ for all i we obtain our original Theil index (3), which we now call the unweighted absolute Theil index. Indices with equal weights ($w_i = 1/I$) and general references may accordingly be called unweighted relative Theil indices.

As mentioned above, for our study the index i denotes the 31 Chinese provinces (thus I=31). The variable X_i denotes the supply of higher education opportunities in province i, which we

[12] The GE(2), which can be directly obtained from formula (1), is a simple monotonic transformation of the (frequently used) coefficient of variation (CV). More specifically we have GE(2)=0.5CV^2.

[13] The whole class of general entropy measures GE(α), including the GE(0) and GE(2) measures used for our robustness tests, have been generalised in the same way (for details see Bickenbach and Bode (2008)).

proxy by the number of universities or the number of newly enrolled students in province *i*, respectively. This still leaves us with the choice of a set of weights w_i and references $\prod_i$.

The role of weights and references can best be illustrated by comparing formula (4) to formula (3) of the unweighted absolute Theil index. The province-specific weight w_i, which replaces the parameter *1/I* of (3), enables us to redefine the basic units of analysis and thus grant different weights to different provinces. For example, instead of giving each province the same weight as in the unweighted Theil index (3), we may now decide to give every inhabitant of China the same weight, which implies that the provinces are assigned different weights corresponding to their shares in total population when calculating the inequality measure. In other words, a given level of undersupply (or oversupply) of higher education opportunities (relative to the mean) in a specific province is given a greater weight in calculating the inequality measures, and is thus considered to contribute more to overall inequality, if that province is larger in terms of population relative to the other provinces.

The second difference to formula (3) is that a province-specific reference $\prod_i$ is explicitly considered in the more generalised formula (4). The introduction of province-specific references enables us to investigate the inequality across provinces of the distribution of universities or university places relative to relevant reference variables, which we consider important in assessing the (inequality of) higher education opportunities in the different provinces. The absolute Theil index without province-specific references (formula (3)) takes its minimum value of zero, which is to be interpreted as perfect equality, if our variable of interest *X*, e.g., the number of universities or university places, takes the same value for all provinces. The introduction of province-specific references $\prod_i$ allows us to redefine this perfect equality benchmark (and the corresponding concept of equality). For example, by taking the size of the (young) population in the different provinces as the reference implies that an equal distribution of university places is no longer defined as the case of an equal absolute number of universities/university places in each province but as an equal ratio of universities/university places to (young) inhabitants in each province. In other words, aiming for equality now implies that the number of university places should be proportional to the size of the young population. More generally, the relative Theil index of inequality is zero if

the distribution of the variable of interest X across provinces is proportional to that of the reference variable $\prod$, and it is strictly positive otherwise.[14]

In our empirical analysis of Section 3.2 we will also make use of different specifications of weights and references thereby focusing on different facets of the issue of the inequality of higher education opportunities across Chinese provinces. As to the choice of weights we will calculate both unweighted Theil indices (w_i=1/31) as well as population-weighted Theil indices, where the weights of the individual provinces are given by their shares of total Chinese population. As to the choice of references, we will make use of several alternative variables—total population, population under age 15, non-agricultural employees and GDP (per capita)—that correspond to different supply side, demand side and development policy considerations on higher education opportunities. A discussion of the motivation for our different choices of weights and references and the implications for the interpretation of the resulting measures are provided when we present our empirical results in Section 3.2.

As mentioned above, we will make explicit use of the decomposability property of the GE class measures of inequality, which allows us to trace (changes in) the inequality of higher education opportunities across all provinces to (changes in) the inequality *within* and (changes in) the inequality *between* subgroups of provinces, that we define on the basis of geographic (4 subgroups) and economic development (2 subgroups) criteria.

Technically, the decomposition of the weighted relative Theil index, T^{wr}, into a within-group component and a between-group component is given by:

$$
\begin{aligned}
T^{wr} &= T^{wr}_{within} + T^{wr}_{between} \\
&= \sum_{r=1}^{R} w_r \frac{\sum_{i\in r} \frac{w_i}{w_r}\frac{X_i}{\Pi_i}}{\sum_i w_i \frac{X_i}{\Pi_i}} \sum_{i\in r} \frac{w_i}{w_r} \frac{\frac{X_i}{\Pi_i}}{\sum_{i\in r} \frac{w_i}{w_r}\frac{X_i}{\Pi_i}} \ln\left(\frac{\frac{X_i}{\Pi_i}}{\sum_{i\in r} \frac{w_i}{w_r}\frac{X_i}{\Pi_i}}\right) + \sum_{r=1}^{R} w_r \frac{\sum_{i\in r} \frac{w_i}{w_r}\frac{X_i}{\Pi_i}}{\sum_i w_i \frac{X_i}{\Pi_i}} \ln\left(\frac{\sum_{i\in r} \frac{w_i}{w_r}\frac{X_i}{\Pi_i}}{\sum_i w_i \frac{X_i}{\Pi_i}}\right),
\end{aligned}
\tag{5}
$$

where r=1,…, R denotes the mutually exclusive (sub)groups of provinces and

$$w_r = \sum_{i\in r}^{I_r} w_i .$$

[14] The upper bound of the weighted relative Theil index is $\ln(1/w_{\min})$, where $w_{\min}$ is the smallest weight. For an unweighted Theil index the upper bound is, thus, given by $\ln(I)$.

The within-group component, T_{within}^{wr}, corresponds to the weighted average of the inequality between provinces *within* each group r (r = 1, …, R), which is calculated based on the deviations of the relative higher education opportunities ($X_i/\prod_i$) of each province of a group from the (weighted) group mean. The between-group component, $T_{between}^{wr}$, corresponds to the inequality in the higher education opportunities between the group and is calculated based on weighted deviation of the group mean of a certain group from the overall mean.[15]

3.2 Regional inequality: empirical results

Absolute inequality

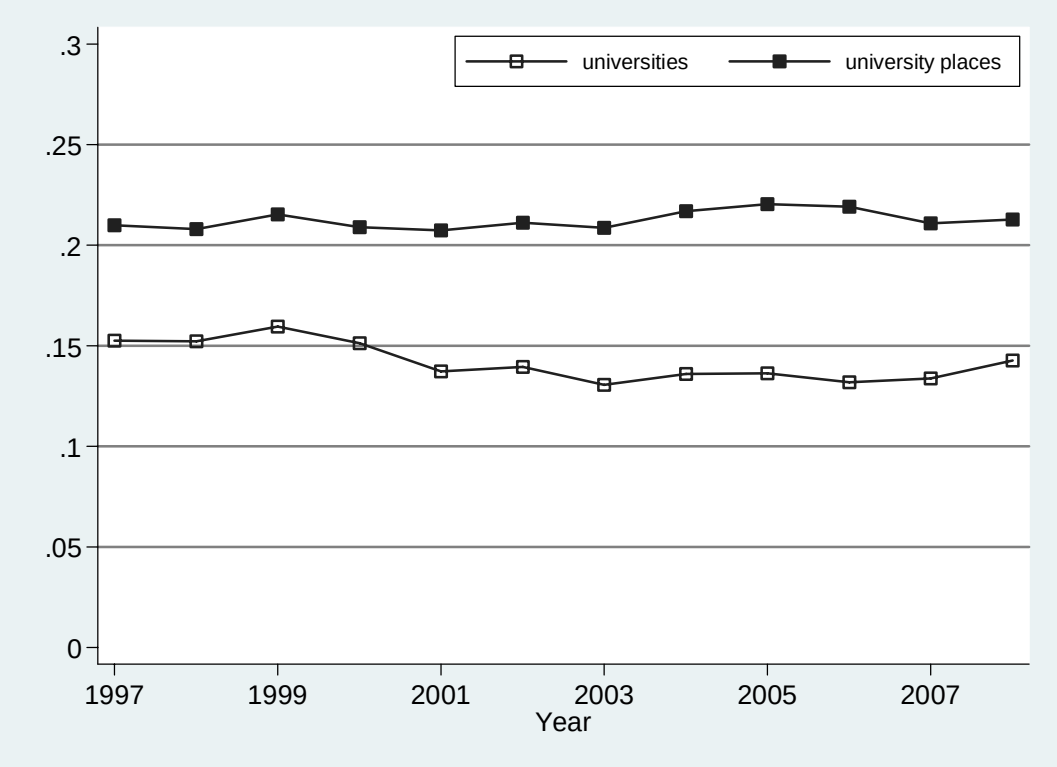
Aggregate statistics presented in Section 2 show that both the number of universities and the number of newly enrolled students (university places) have increased substantially since 1999. Against the background of such a strong scale expansion, the distribution of universities and university places between the most advances (Coastal) and the least advanced (Western) regions in China seemed to be only slightly different in 2008 from the corresponding distribution in 1998. However, when turning to a geographically more disaggregated level, even a brief look at the data shows that the number of universities, the number of students, and their changes over time differ quite substantially across Chinese provinces. In 1997, the first year of our observation period[16], there were only four universities in Tibet and five in both Ningxia and Hainan, but there were 65 universities both in Beijing and in Jiangsu. While there was a substantial increase in the numbers of universities in all provinces over the observation period, the differences across provinces remained substantial. In 2008, there were six universities in Tibet and nine in Qinghai but as many as 125 in Guangdong and in Shandong and even 146 in Jiangsu. The increase in the number of universities varied between 30.7% in Beijing (from 65 universities in 1997 to 85 in 2008) and 37.5% in Jilin (from 40 to 55) to about 206% in Anhui (from 34 to 104) and even 220% in Hainan (from 5 to 16). In a large majority of almost two-thirds of provinces the number of universities increased between 100% and 200%.

[15] Similar decomposition formulas hold for the GE(0) and the GE(2) measures, which are used for robustness analyses in Section 3.2.

[16] There are two reasons for us to choose 1997 as the first year of the panel dataset for analysis. First, this was the year when Chongqing was upgraded to be the fourth municipality of China, next to Beijing, Tianjin and Shanghai. Starting with 1997 enables us to work on the largest balanced panel dataset, which was available at the time when data were collected. Second, starting with 1997 but not later enables us to have at least two years of data for the period before the large-size scale expansion in higher education in China.

As a measure of the overall inequality of the number of universities across provinces, or the concentration of universities across provinces, we calculated, for each year between 1997 and 2008, the unweighted absolute Theil index of the number of universities across provinces. The development over time of this Theil index is displayed in Figure 2 (line with hollow squares). The value of the Theil index slightly decreased from 0.153 in 1997 to 0.143 in 2008, with a maximum (minimum) value of 0.160 (0.131) in the year 1999 (2003). There is thus only little change and no clear time trend in the measure between 1997 and 2008.

Figure 2: Inequality in distribution of universities and university places across provinces (unweighted absolute Theil index)



Sources: MOE(b) (various years). Own calculations.

As universities differ in size (the number of students), the number of universities in a province is obviously only a very rough measure of the opportunities of potential students to obtain higher education in the different provinces. We may therefore prefer to look at the distribution of the number of students, or even better the number of newly enrolled students, across provinces. Figure 2, therefore, also displays, for each year, the unweighted absolute Theil index (of the concentration) of the number of newly enrolled students across provinces (line with filled squares). A comparison of the two measures shows that the concentration, or inequality, of newly enrolled students across provinces is substantially larger than the

concentration of the number of universities both in 1997 and in 2008.[17] Actually the total number of newly enrolled students varies from 717 in Tibet and 2,619 in Qinghai to 58,168 in Hubei and 78,424 in Jiangsu (more than 100 times the number of Tibet) in 1997 and from 8,520 in Tibet and 13,767 in Qinghai to 410,705 in Jiangsu and as many as 465,593 in Shandong in 2008.

Similar to the concentration of universities, the concentration of newly enrolled students across provinces is fairly constant over time. The unweighted absolute Theil index of newly enrolled students increased only very slightly from about 0.210 in 1997 to 0.213 in 2008, with a maximum (minimum) value of 0.220 (0.207) in the year 2005 (2001). This reflects the fact that—despite very high absolute growth rates of the number of newly enrolled students—the *distribution* of the 31 provinces' *shares* of all newly enrolled students remains *overall* fairly constant over time.[18] As for the number of universities, this does not imply that there was no change in the number of newly enrolled students or in the shares of individual provinces in the total number of students newly enrolled, it rather suggests that the increase in the number of students was overall "quite" proportional, i.e. similar in relative terms, across provinces. This is true although the increase in the number of newly enrolled students varies from about 173% in Beijing (from 57,124 to 156,092) and 216% in Shanghai (from 45,371 to 143,328) to 884% in Hainan (from 4,038 to 39,735) and 1,088% in Tibet (from 717 to 8,520). Still for a large majority of almost two-thirds of provinces the increase from 1997 to 2008 in the number of newly enrolled students lies between 400% and 600%.

Relative inequality

The analysis so far does not consider differences in the size of the population of the different provinces. As the population sizes of Chinese provinces vary very substantially—in 2008 the population size varied between less than three (2.9) million in Tibet and about 94 million in Shandong—we can hardly consider it a reasonable political objective to have an equal or similar absolute number of universities or university places (or students) in all provinces, disregarding the differences in their sizes. In discussing the inequality in the supply of higher education opportunities across provinces we therefore have to take into account the

[17] This indicates that universities are on average larger (in terms of newly enrolled students) in provinces with a high numbers of universities as compared to provinces with low numbers of universities.

[18] Qualitatively quite similar results as for the Theil index, i.e. the GE(1)—the concentration of newly enrolled students is larger than the concentration of universities; both concentration measures are fairly constant over time—are obtained for two alternative general entropy (GE) measures, namely for the GE(0) and GE(2) (see Figure A in Appendix). As this is largely true for all of our analysis, we will only focus on the results for the Theil index in the following.

differences in the sizes of the different provinces; and in evaluating changes in inequality over time we also have to take into account that the population of provinces are growing at grossly different rates, so that the relative sizes of the provinces as measured by their shares in overall population are also changing over time. For example, while population shrank by about 6.7% in Chongqing and by about 3.5% in Sichuan it increased by about 35%in Guangdong and by about 37% in Beijing over the time period considered.

Fundamentally, there are two mutually non-exclusive ways in which our analysis can account for provinces' different population sizes (cf. Section 3.1). The first way is to consider the distribution across provinces of universities per capita (or newly enrolled students per capita) rather than the distribution of the absolute number of universities (or newly enrolled students). In the terms of Section 3.1, this amounts to taking provinces' population sizes as the *reference* in calculating relative Theil indices. The other way is to *weight* provinces by the size of their population when calculating the index. Instead of provinces as in the unweighted Theil index it is the individual inhabitants that are given equal weights in calculating the population-weighted Theil index. This implies that the undersupply of universities or university places in a given province is taken to be a larger deviation from an equal supply, and thus a potentially larger problem for equality, if this province is larger in terms of population.

Figure 3 displays for each year between 1997 and 2008 the unweighted relative and the population-weighted relative Theil indices both for the number of universities and for the number of newly enrolled students. Bearing the findings from Figure 2 in mind, there is a number of important observations from Figure 3:

Firstly, at the beginning of the observation period, the unweighted relative Theil indices for both the number of universities (hollow circles) and the number of newly enrolled students (filled circles) were even higher than the corresponding unweighted absolute Theil indices displayed in Figure 2. This implies that in 1997 universities and university places were even more unequally distributed across provinces once we consider their supply relative to the provinces' different population sizes.

Secondly, the weighted relative Theil indices for both the number of universities (hollow diamond) and the number of newly enrolled students (filled diamond) are lower—in the early

years even substantially lower—than the corresponding unweighted relative measures.[19] They are also lower than the corresponding absolute measures. The lower values for the population-weighted as compared to the unweighted relative indices indicate that deviations from the average number of universities or students per inhabitant are on average more pronounced in smaller provinces (for more on this see below).

Thirdly—and this is the most important observation from Figure 3, and the most striking difference to Figure 2—there is a strong and fairly monotonic decline over time of all relative Theil indices displayed in Figure 3.[20] As a consequence these relative inequality measures are substantially lower than the corresponding absolute measures (c.f. Figure 2) at the end of the observation period. Generally, the decline in inequality is stronger for the number of newly enrolled students than for the number of universities. It is also slightly stronger for the unweighted measures (circles) than for the weighted measures (diamonds).[21]

The strong decline in the relative measures suggests that the inequality across provinces in the supply of higher education opportunities per capita has decreased substantially between 1997 and 2008. While there are some quantitative differences between the development in the concentration of universities per capita and the concentration of newly enrolled students per capita, the general development is the same for both variables—both have decreased substantially over time. In the following discussion we therefore focus on only one of the two variables. Given that universities may be of very different sizes the number of university places or newly enrolled students is generally a better proxy for the supply of higher

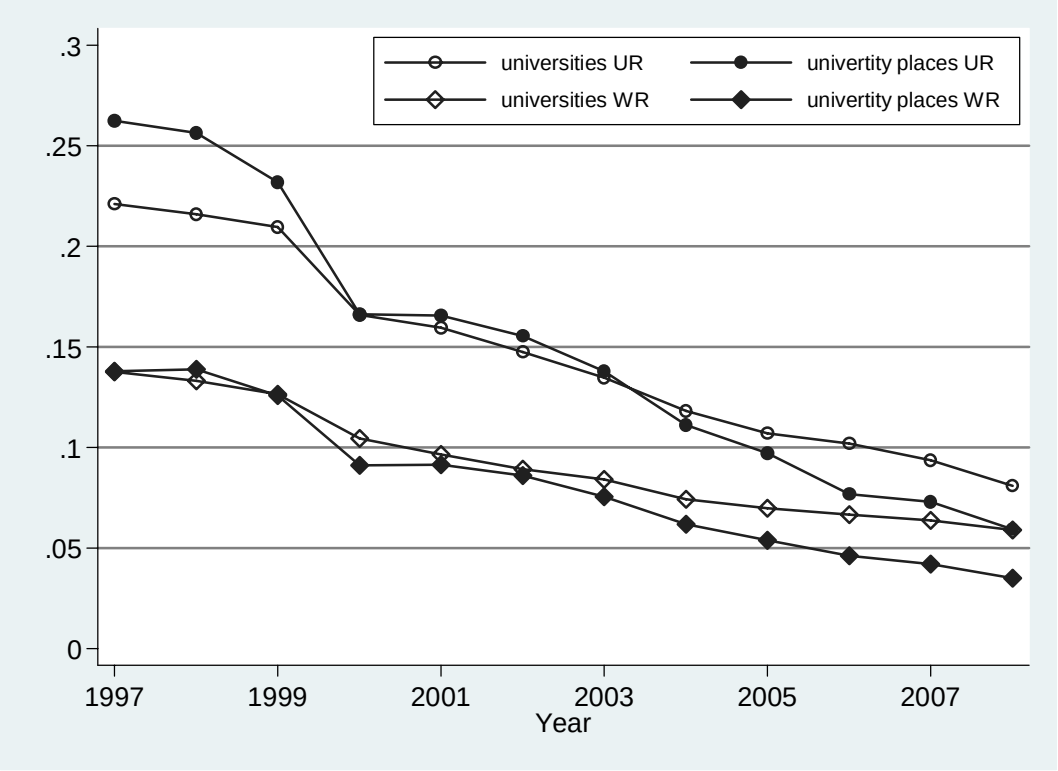
[19] Only in the early years of the observation period the unweighted relative Theil index was higher for the number of newly enrolled students (filled circles) than for the number of universities (hollow circles), as was the case for the absolute Theil indices displayed in Figure 2. (There was no such difference for the weighted relative Theil index.) In later years, by contrast, inequality was higher for the number of universities than for the number of newly enrolled students for both the weighted and the unweighted measures. This suggests that universities were on average larger (in terms of newly enrolled students) in larger provinces (in terms of population).

[20] For most of the inequality measures displayed in Figure 3, there is a particularly strong decrease of inequality between 1999 and 2000 (we will see similar effects for several of the measures discussed in the further course of our analysis). As 1999 and 2000 were the first years of the new policy of an enforced expansion of higher education opportunities and as the increase in the number of new students (but not the number of universities that saw its greatest expansion between 2001 and 2004) was particularly large in 1999 and 2000 (with an increase of more than 40% in each of the two years), one could conjecture that the exceptionally strong decline in inequality in these years may be a consequence of this rapid expansion. We can show, however, that the strong decrease in 2000 is mainly due to some extreme variation in the population data for some of the provinces for the year 2000. This is also the reason why a corresponding decline for 2000 has not been observed for the absolute indices displayed in Figure 2 that do not make use of these population data. .

[21] The difference in the *rate* of decline between weighted and unweighted measures is relatively small, however. For the number of universities (the number of new students enrolled) the unweighted relative Theil index declines by about 63.3% (77.4%) whereas the weighted relative Theil index declines (only) slightly less by about 57.2% (74.6%).

education opportunities than the number of universities. In the following, we will therefore focus on the concentration of newly enrolled students.

Figure 3: Inequality in distribution of universities and university places across provinces relative to population size (unweighted relative (UR) and weighted relative (WR) Theil indices)



Sources: MOE(b) (various years) and NBSC(a) (various years). Own calculations.

The weighted relative Theil index for the number of newly enrolled students (filled diamonds) decreased substantially between 1997 and 2008 (from 0.138 to 0.035). The corresponding unweighted relative Theil index (filled circles) is larger and decreased slightly more strongly (from about 0.263 in 1997 to about 0.059 in 2008). The decrease of the two indices indicates a decline in the inequality across provinces of the number of newly enrolled students per capita. For example, in 1997 there were as few as 29 newly enrolled students per 100,000 inhabitants in Tibet and just 36 per 100,000 inhabitants in Guizhou while the corresponding numbers were 311 in Shanghai and 461 in Beijing. In 2008 this ratio was higher in all provinces; it was the lowest in Guizhou with 226 and Yunnan with 243 and the highest in Beijing with 921 and Tianjin with a ratio of 944. While the differences in these ratios across provinces were still quite substantial in 2008 they were much smaller than in 1997 (in relative terms). The higher values of the unweighted as compared to the weighted Theil index reflects the fact the

provinces with the lowest and those with the highest number of newly enrolled students per capita are generally of comparatively small (Tibet, Tianjin, Beijing, Shanghai), or medium (Guizhou, Yunnan) size in terms of their population while the student to population ratios in the large provinces are closer to the average values across provinces.

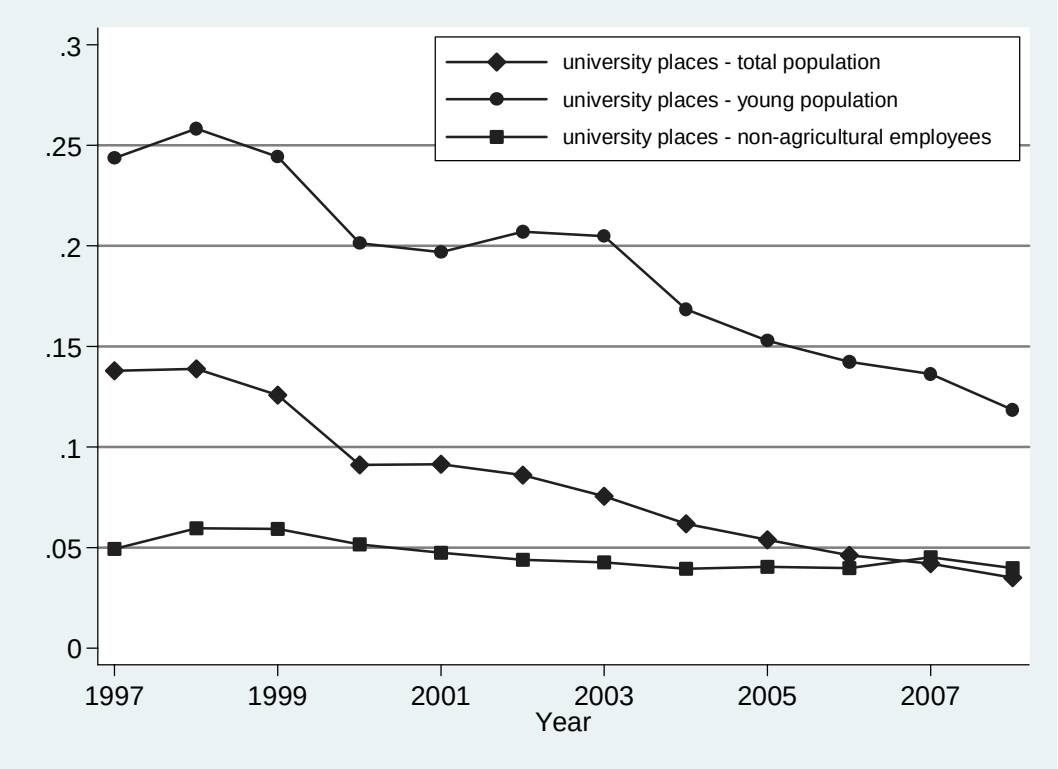
Given the difference identified between the results for the absolute inequality indices (Figure 2) and the results for the relative inequality indices (Figure 3), we may wonder whether the results for the relative indices—in particular the strong increase of inequality over time—hold true for alternative reference variables that may be equally well or even better suited for our research purpose than the provinces' total population sizes. Two alternative references are (i) the size of the population under age 15 and (ii) the number of non-agricultural employees. Given differences in the age structure of the provinces, the size of the population under 15 as a proxy of the size of the young population may be considered a better indicator of the regional supply of potential students and thus the demand for university places than the overall population size. Similarly, given differences in the (structural) economic development of the provinces the number of non-agricultural employees may be considered a better indicator of the demand for higher education graduates in the provinces' labour markets than the overall population.[22]

Figure 4 displays the relative weighted Theil indices for the number of newly enrolled students for these two alternative references (filled circles for population under age 15 and filled squares for non-agricultural employment). For ease of comparison Figure 4 also displays once again the relative weighted Theil index with the population size as the reference (filled diamonds) from Figure 3. For all three Theil indices we take provinces' total populations as weights as before. Our choice not to use the population under age 15 or the non-agricultural employment as weights is based on the presumption that an adequate supply of higher education opportunities is in the interest of the whole population (and not just the young population or non-agricultural employees).[23]

[22] Our choice of *non-agricultural* employment as a proxy for the demand for high-skilled workers is justified by the fact that manufacturing and services are more high-skill intensive than (traditional) agriculture (NBSC(b) (2009)). This tendency is likely to be reinforced by the government-promoted shift towards the production of more technologically advanced products and an increasing importance of more complex, knowledge-intensive services.

[23] We have also calculated the unweighted relative Theil indices for the three references as well as the corresponding weighted and unweighted Theil indices for the number of universities. The results of these calculations, which are not presented here, are largely in line with the results presented here.

Figure 4: Inequality in distribution of university places across provinces relative to alternative size measures (weighted relative Theil indices)



Sources: MOE(b) (various years) and NBSC(a) (various years). Own calculations.

From Figure 4 we observe that the weighted relative Theil indices for all three references are falling between 1997 and 2008. While the decline in the index with total population as reference was particularly strong (75% in relative terms), the absolute decline in the index with non-agricultural employment as reference was comparatively small. Nevertheless, this index was still more than 18% smaller in 2008 than in 1997. As compared to its maximum value in 1998 (0.059) the relative decline was even more than 33%.[24] Taken the population under age 15 as reference, the Theil index declined by about 51%. The results for the alternative reference variables thus confirm the observation that the regional inequality in the supply of university places has strongly decreased between 1997 and 2008 once we take into account the provinces' vastly different population sizes (relative measures). While the decrease was somewhat weaker for the alternative references as compared to the population reference, it was still quite considerable in relative terms.

[24] The unweighted relative measure with the number of non-agricultural employees as reference (not presented here) declines even more strongly—namely by more than 40% from 0.077 in 1997 to 0.046 in 2008.

As to the *levels* of inequality, Figure 4 shows that the inequality across provinces was substantially *larger* for the number of newly enrolled students per inhabitant under age 15 than for the number of newly enrolled students per inhabitant. In contrast, relative to the number of non-agricultural employees the inequality across provinces of the number of newly enrolled students was much *lower* than the inequality relative to the size of total population in the early years of the observation period. Both measures were of similar size at the end of the observation period, however. The differences in the levels of the Theil indices for the three references are reflected by corresponding differences in the span of values of the relative numbers of newly enrolled students. For the number of newly enrolled students per inhabitant under age 15 the span between the maximum and the minimum ratio across provinces is much higher in relative terms than the corresponding span for the number of newly enrolled students per inhabitant which again is much higher than the span for the number of newly enrolled students per non-agricultural employee.[25]

These differences result from the "structural" differences between those provinces that have high ratios of students per capita and those that have low ratios. Provinces with comparatively high students per capita tend to have an older population and a larger share of manufacturing and service sector employment. Compare, for example, the provinces that have the lowest numbers of students per capita, namely Tibet and Guizhou in 1997 and Guizhou and Yunnan in 2008, with those provinces that have the highest number of students per capita, namely Shanghai and Beijing in 1997 and Tianjin in 2008. Tibet, Guizhou and Yunnan still have a much higher share of young people in total population and they also still have a much higher share of agriculture in total employment compared to Shanghai, Beijing and Tianjin. Both with respect to the demographic change towards an older population and with respect to the structural transition of the economy from agriculture to manufacturing and services the first group of provinces is clearly lacking behind the average Chinese province, whereas the second group is leading the Chinese average in these transition processes. Across all provinces, there is a strong (but decreasing) negative correlation between the share of population under age 15 in total population and the share of non-agricultural employment in

[25] The number of newly enrolled students per 100,000 inhabitants under age 15 ranges from 88 in Tibet and 124 in Guizhou to 1,984 in Shanghai and 2,738 in Beijing in 1997 and from 855 in Guizhou and 1,080 in Yunnan to as many as 9,544 in Shanghai and 9,628 in Beijing in 2008, corresponding to a ratio between minimum and maximum of about 1:30 in 1997 and 1:11 in 2008. By comparison, the number of newly enrolled students per 100,000 non-agricultural employees ranges from 209 in Zhejiang and 222 in Henan to 655 in Shanghai and 968 in Beijing in 1997 and from 782 in Guizhou and 812 in Zhejiang to 2,557 in Shaanxi and 2,612 in Tianjin in 2008 corresponding to a ratio of less than 1:5 in 1997 and close to 1:3 in 2008. For the total population reference the corresponding ratios were about 1:12 in 1997 and more than 1:4 in 2008 (for detailed figures see above).

total employment.[26] The share of non-agricultural employment in total employment tends to be largest in the Eastern/Coastal provinces where the opening of the Chinese economy and the accompanying economic reform process started and where structural change and income growth have been strongest. At the same time, these provinces tend to have a larger share of adults in total population due to a stricter enforcement of the One-Child Policy and an immigration of workers (and students) from less advanced, poorer provinces.

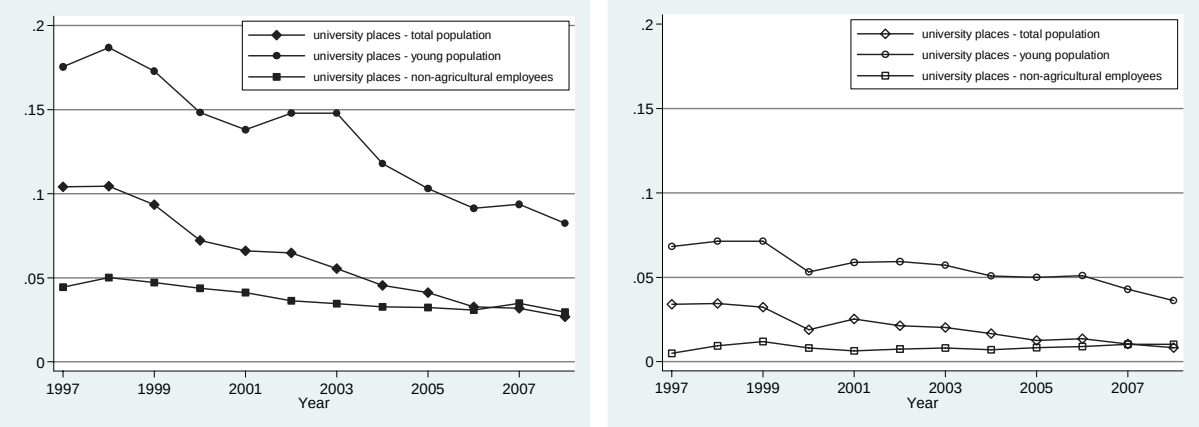
The results displayed in Figure 4 have clearly shown that taking into account the provinces' (highly) different (population) sizes, the inequality across the 31 Chinese provinces in the number of newly enrolled students, as measured by the (population-) weighted relative Theil index, has clearly decreased since 1997. In principle, such a *decline* in the overall inequality across provinces may go along with an *increase* in the inequality between larger regions (or groups of provinces), such as between the comparatively well developed coastal provinces on the one hand and the less developed central or Western provinces on the other hand. To see whether this is actually the case we have adopted the regional classification used by the Chinese government to design its regional development policy, which assigns the 31 provinces, according to their geographical location and developing status, into four regional groups: the Eastern or Coastal region, the North-Eastern region, the Central region, and the Western region. Making use of the well-known decomposition properties of the Theil index (see Section 3.1), we have then decomposed each of the three Theil indices from Figure 4 into a within-group component and a between-group component. For each of the three references the within-group component is equal to the weighted average of the four (respective) relative Theil indices across the provinces within each of the four regions. It is a measure of the average inequality in the number of newly enrolled students across the provinces within the individual regions. The between-group component is the relative Theil index across the four regions. It is a measure of the inequality in the number of newly enrolled students across the four regions. Figure 5 displays the resulting within-region components (left panel) and between-region components (right panel) for each of the three weighted relative Theil indices from above.[27]

[26] The correlation coefficient between the two ratios has been -0.84 in 1997 and -0.52 in 2008.

[27] Thus the weighted relative Theil index with population size as reference (filled diamonds in Figure 4) is, for instance, equal to the sum of the corresponding within-group (filled diamonds in Figure 5) and between-group components (hollow diamonds in Figure 5).

Figure 5: Inequality in distribution of university places across provinces – decomposed by regions (weighted relative Theil indices from Figure 4)

(a) within-group inequality (b) between-group inequality



Sources: MOE(b) (various years) and NBSC(a) (various years). Own calculations.

For all three references the *within-region component*, which is in all cases substantially larger than the between-region component, declined strongly between 1997 and 2008. For the *between-region component* there is a similar decline for the total-population reference (hollow diamonds) and young-population reference (hollow circles).[28] In contrast, relative to the number of non-agricultural employment the between-group inequality of newly enrolled students increased between 1997 and 2008. Actually, for this reference the between-region measure was about twice as high in 2008 as in 1997, whereas the within-region measure has decreased by about a third. While the between-region inequality for non-agricultural employment was comparatively low in all years and took its highest value in 1999, where it was slightly higher than in 2008, the development of this between-group inequality might nevertheless raise concerns that the regional inequality in higher-education opportunities may actually increase in the (unequal) process of economic development in China.

Inequality in higher education and regional economic development

In further investigating this issue it is useful to take differences in provinces' economic development, measured by GDP per capita of Chinese provinces, more directly into account both in defining the reference of the inequality measure and in defining groups of regions for our decomposition analysis. We thus calculated the weighted[29] relative Theil indices for the

[28] For both these references the *relative* decline of the between-region component is of very similar size as the decline of the within-region component. Both components decline by about 75% for the population reference and by close to 50% for the population-under-15 reference.

[29] As in the previous section, the population share by province is used as the weight here.

number of *newly enrolled students per capita* with the *GDP per capita* as reference.[30] We also divided the set of 31 provinces into two groups—the "poor provinces" comprising the 16 provinces with per capita GDP at or below the GDP per capita of the median province in 1997, and the "rich provinces" comprising the 15 provinces with GDP per capita above that of the median province in 1997.[31] We used this distinction into a group of poor provinces (group 1) and a group of rich provinces (group 2) to calculate the corresponding within- and between-groups Theil indices. This allows us to investigate how the inequality in the number of newly enrolled students per capita over GDP per capita evolved both between and within the groups of rich and poor provinces. The corresponding weighted relative Theil indices across all 31 provinces and the between-and within-group components are displayed in Figure 6. In addition, Figure 7 displays the weighted relative Theil indices for the two groups, the group of "poor provinces" and the group of "rich provinces"; for ease of comparison it also displays again the between-group component from Figure 6.[32]

From Figure 6 we see that the weighted relative Theil index (filled squares) takes a value of about 0.06 both in 1997 and in 2008 with some fluctuation, but no clear trend, in between these two years. Comparing this value to the values of the three weighted relative Theil indices displayed in Figure 4, we note that it is considerably lower than the Theil index with population under age 15 as the reference; it is also considerably lower than the measure with total population as the reference in the early years of the observation period, but higher than this measure at the end of the observation period. Overall the level of the Theil index of newly enrolled students per capita over GDP per capita (from Figure 6) is more similar in size, though somewhat larger, than the Theil index for the non-agricultural employment reference from Figure 4.[33]

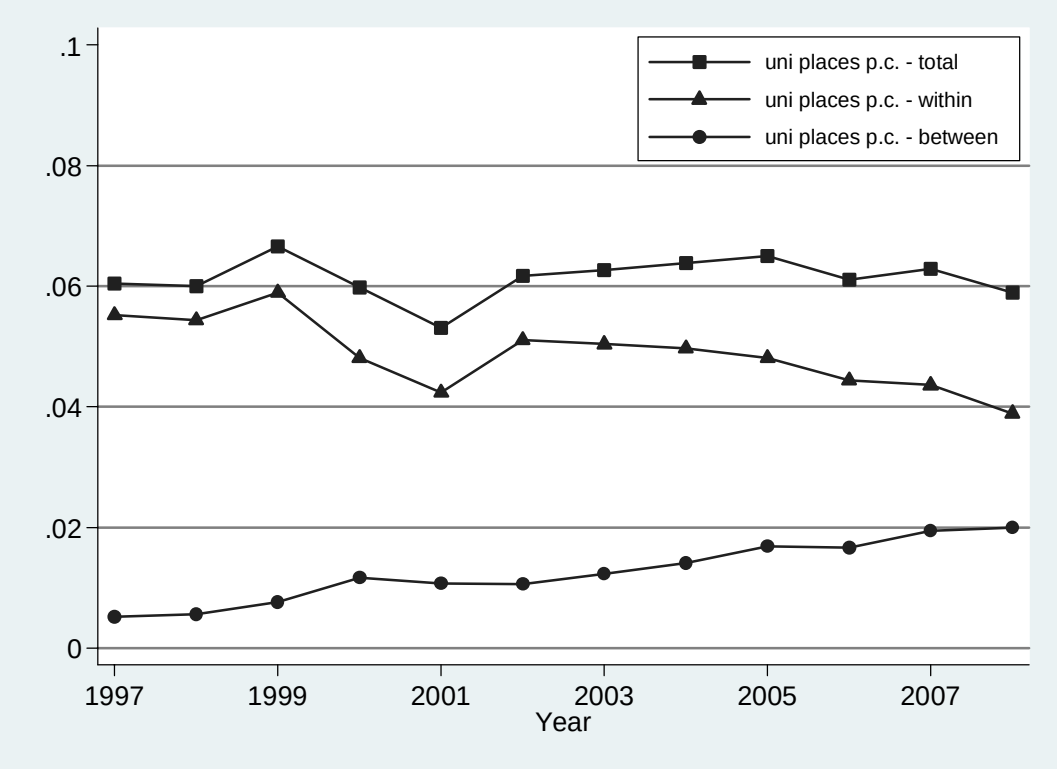
[30] Technically the calculation of this weighted relative Theil index can be simplified to the calculation of the weighted relative Theil index of the number of newly enrolled students with provincial GDP as reference—i.e., the population size from the numerator (newly enrolled students per capita) and the denominator (GDP per capita) of the relative Theil index can be cancelled out.

[31] While the two groups are not defined geographically but by their GDP per capita, the classification is correlated with the above classification into four geographically defined groups. Actually all Western and Central provinces with the exception of Hubei and Xinjiang belong to the group of poor provinces, whereas all Eastern/Coastal and North-Eastern provinces belong to the group of rich provinces.

[32] The within-group Theil index displayed in Figure 6 is thus the weighted average of the Theil indices for the two income groups displayed in Figure 7.

[33] The similarity of the values of the latter two measures reflects the fact that structural change of employment away from agriculture towards manufacturing and services and the increase in GDP per capita go largely hand in hand in the economic development process. More technically, for each year the correlation between the level of non-agricultural employment and GDP across provinces is close to 0.9.

Figure 6: Inequality in distribution of university places p.c. across provinces relative to GDP p.c. – decomposed by income groups (weighted relative Theil index)



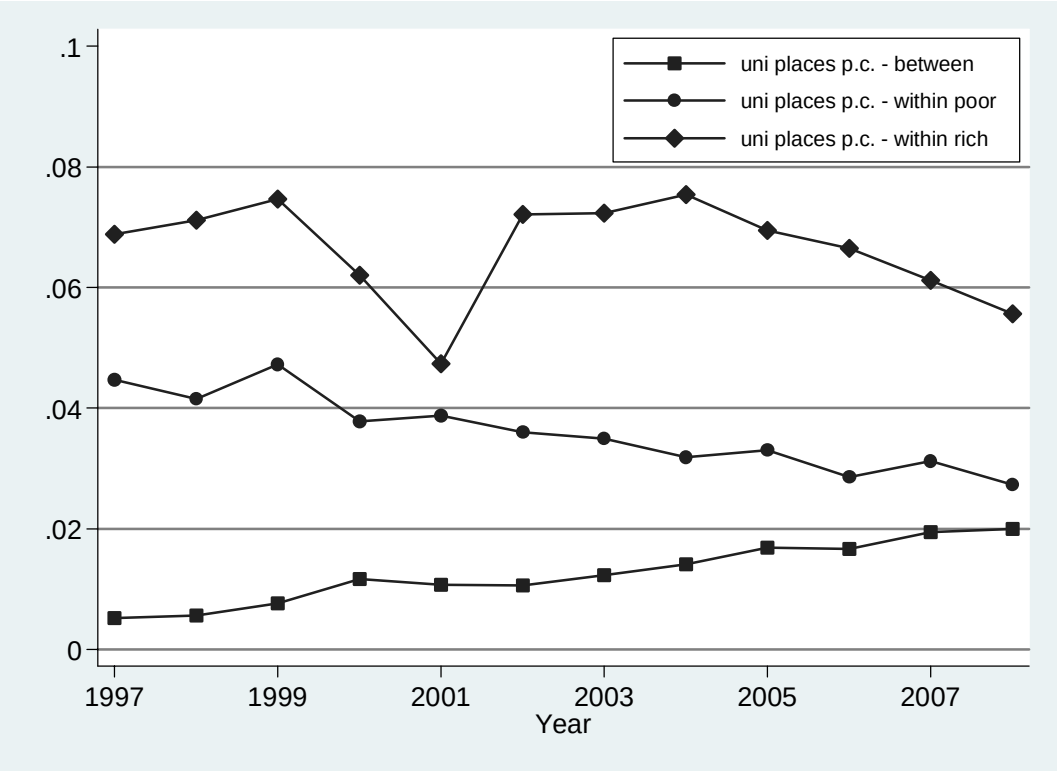
Sources: MOE(b) (various years) and NBSC(a) (various years). Own calculations.

The fact that the relative inequality measure with GDP as reference is largely constant over time is in clear contrast to the decline over time of all of the relative measures from Figure 4. While the decline in inequality was less pronounced for the non-agricultural employment reference than for the population and the population-under-15 references, it was still significant for that reference as well. From our decomposition analysis we see that the (relative) constancy over time of the inequality of the number of newly enrolled students per capita over GDP per capita is the result of two quite different development of the corresponding inequalities within and between our groups of "rich" and "poor" provinces. While our measure for the within group-inequality (filled triangles) has decreased over time, the measure for the between-group inequality (filled circles) has increased over time.[34] From Figure 7 we see, in addition, that the decline in the within-group component corresponds to a decline of inequality within both income groups. The inequality within the group of provinces

[34] We also calculated the corresponding unweighted measures for robustness checks. The trends over time for both the between-group component (increasing) and the within-group component (decreasing) are the same for the unweighted measure as for the weighted measure. As the increase of the between-group component is somewhat weaker and the decrease of the within-group-component somewhat stronger for the unweighted measure, however, the overall unweighted relative Theil index for the GDP reference declined between 1997 and 2008 (from about 0.07 to about 0.057), whereas the corresponding weighted index displayed no such trend.

with low GDP per capita (filled circles) declined quite considerably, and rather monotonically, over time. The inequality within the group of provinces with comparatively high GDP per capita (filled diamonds)—which was substantially larger than the inequality within the other group—was also higher in 1997 than in 2008, it exhibited a clear downward trend only after 2004, however.

Figure 7: Inequality in distribution of university places p.c. across provinces, relative to GDP p.c. – between and within individual groups (weighted relative Theil index)



Sources: MOE(b) (various years) and NBSC(a) (various years). Own calculations.

Of particular interest for the issue of the inequality of higher education opportunities in the development process is the development over time of the between-group component. Starting from a (very) low level the between-groups components increased very considerably at least in relative terms (Figure 6). For the weighted Theil index the between-group component accounted for only about 8.6 % of the overall Theil index in 1997 but for more than one third (about 34 %) of the overall Theil index in 2008.[35]

[35] For the unweighted Theil index the corresponding shares were 1.3% in 1997 and about 21% in 2008, respectively.

The level of the between-group inequality (and its increase over time) alone does not indicate whether the supply higher education opportunities was relatively larger in the poor or in the rich regions. Additional calculations[36] show, however, that the ratio of newly enrolled students per capita to GDP per capita was *larger* on aggregate for the group of poor provinces than for the group of rich provinces for all years, and that the difference between the groups has increased considerably over time (in relative terms). While the ratio was about 20% larger for the poor provinces than for the rich provinces in 1997 that relation was almost 60% in 2008.[37] We can also show that this increase is not due to a particularly strong increase of GDP per capita in the rich provinces. Actually, GDP per capita has increased slightly more strongly in the poor provinces (305% between 1997 and 2008) than in the rich provinces (286%). The difference in the increase in the number of newly enrolled students per capita was much larger, however. It was about 580% (from 60 students per 100,000 inhabitants to about 410 per 100,000) in the poor provinces and about 395% (from 104 students per 100,000 inhabitants to 517 per 100,000) in the rich provinces. Thus, while the number of newly enrolled students per 100,000 inhabitants was about 73% higher in the rich provinces than in the poor provinces in 1997, that ratio shrank to slightly more than 25% in 2008. At the same time, the GDP per capita was still about twice as high in the rich provinces than in the poor ones.

4 Summary and discussion

In light of increasing global competition and rising labour costs the Chinese government, by the end of the 1990s, recognised innovation and upgrading of production processes crucial for the Chinese economy's ability to sustain its high-speed economic growth in the future. And it also recognised the importance of a highly qualified labour-force for the success of innovation and upgrading strategy. To increase the provision of highly qualified labour and to improve the average educational level of the population, the Chinese government has continuously reformed the higher education system. It attempted to transform the higher education system from the one focusing on elite education to the one promoting mass education through a substantial scale expansion of higher education. Between 1998 the last year before the

[36] Detailed figures can be obtained upon request.

[37] Dividing each of the two groups of provinces further into two sub-groups, we see that the ratio of students per capita to GDP per capita is also higher for the 8 poorest provinces than for the richer 8 of the 16 poor provinces, and it is higher for the 8 poorer of the rich provinces than for the 7 richest provinces. (It is also higher for the richer of the poor provinces than for the poorer of the rich provinces). However, the difference in the ratio between the poorest provinces and group of richer of the poor provinces has declined between 1997 and 2008; the difference between the poorer of the rich provinces and the richest provinces has also declined, if only slightly, after 2003, but has increased before.

expansion and 2008 the number of newly enrolled students grew six-fold. Along with the massive increase of higher education opportunities in general, the Chinese government intended to narrow the gap between the differing higher education opportunities across Chinese provinces as part of its regional development strategy. The poor Western provinces, in particular, were supposed to receive preferential treatment and specific support from the government in this regards.

Using a balanced provincial panel dataset from 1997 to 2008, we empirically analysed the level and development over time of the inequality in the distribution of higher education opportunities across the Chinese provinces in general, and across groups of provinces with different development levels in particular. To do so, we calculated a series of generalised (weighted relative) Theil indices, which allowed us to explicitly consider the heterogeneity in the provinces' sizes and structural development levels.

The differences in the results obtained for the absolute Theil index and alternative unweighted and population-weighted relative Theil indices clearly demonstrate the importance of these considerations. For both universities and university places (newly enrolled students) the absolute Theil index of inequality stayed roughly constant over time. Disregarding the substantial differences in provinces' sizes, the scale expansion did not seem to make any significant contribution to the reduction of regional higher education inequality. However, we can hardly consider it a reasonable political objective to have an equal or similar absolute number of universities or university places (or students) in all provinces, disregarding their differences in size. We therefore proceeded by calculating the unweighted and population-weighted Theil indices for the inequality of the distribution of university places relative to different proxies for provincial size: total population, young population and non-agricultural employees. Irrespective of the specific size proxy considered, the relative Theil indices displayed a clear downward trend over the research period, implying that university places actually became more equally distributed among provinces during the scale expansion period, when taking different provincial sizes, and thus potentially different demand for higher education, into account. Making use of the decomposability property of the Theil index and focusing on the population-weighted relative Theil indices we also found that the regional inequality of university places *within* the four regions (Coastal, Central, Western and North-Eastern) decreased on average, irrespective of the specific size reference. Regarding the inequality *between* the four regions the finding was less conclusive, however. While the

between-region inequality decreased when considering total population and young population as references, the between-region inequality of university places increased relative to non-agricultural employment. The corresponding value—though comparatively low in absolute terms—was actually about twice as high in 2008 as it was in 1997. This increase in between-region inequality may give rise to concerns that the disadvantage of poorer, less developed regions in terms of higher-education opportunities may have increased, rather than decreased as intended by the government, during the period of the expansion of the higher education system in China.

To investigate the issue of higher education inequality and unequal economic development across provinces more directly, we calculated the (population-weighted) Theil index of university places per capita relative to GDP per capita and its decomposition in the inequality within and between comparatively "rich" and "poor" provinces. The overall index turned out to be relatively constant over time suggesting that the inequality in the distribution of university places per capita relative to the economic development of provinces did not decrease during the expansion period. The decomposition analysis showed, however, that the relative constancy over time of the inequality of the number of university places per capita over GDP per capita is the result of opposing developments of the corresponding inequalities within and between groups of rich and poor provinces. While the within-group inequality decreased over time, the between-group inequality increased. This increase was not realised at the expense of poor provinces, however. Quite the contrary, the increase in between-group inequality was driven by a much stronger increase in the number of university places per capita in the poor provinces than in the rich provinces. The relative difference of university places per capita between the rich and the poor regions decreased from 1.73:1 in 1997 to 1.25:1 in 2008.

In sum, our empirical analysis showed that, during the period of rapid expansion of the higher education system, the inequality in the distribution of higher education opportunities across different provinces in China decreased, when taking into account the substantial differences in the sizes of provinces. It also showed, that the inequality in the provision of university places per capita relative to GDP per capita between the poor and rich provinces increased and that this increase was in favour of the poor provinces, which realised an increasing advantage over rich provinces with respect to the number of university places relative to GDP (and a

corresponding decline in their disadvantage with respect to the number of university places per inhabitant).

These results are largely consistent with the announced (regional) development priorities of the Chinese government, which intended to massively expand the scale at the higher education system and at the same time reduce the inequality of higher education opportunities in favour of backward provinces. The analysis and the findings of the paper contribute to the ongoing public debate on the unequal higher education opportunities across provinces in China. Our analysis focused on the purely quantitative but nonmonetary aspect of the distribution of higher education opportunities, based on two university-related variables, namely the number of universities and the number of students. The monetary aspect (financial investment in higher education) and the qualitative aspect of inequality of higher education opportunities across Chinese provinces have been left for future research. The third even more fundamental issue that has not been addressed in this paper but been left for future research is the question of whether a more equal distribution of higher education opportunities across provinces in general and a preferential treatment of the least developed Western regions in particular may really be considered an effective or even economically efficient way to promote sustainable economic growth in general and economic convergence between provinces in particular.

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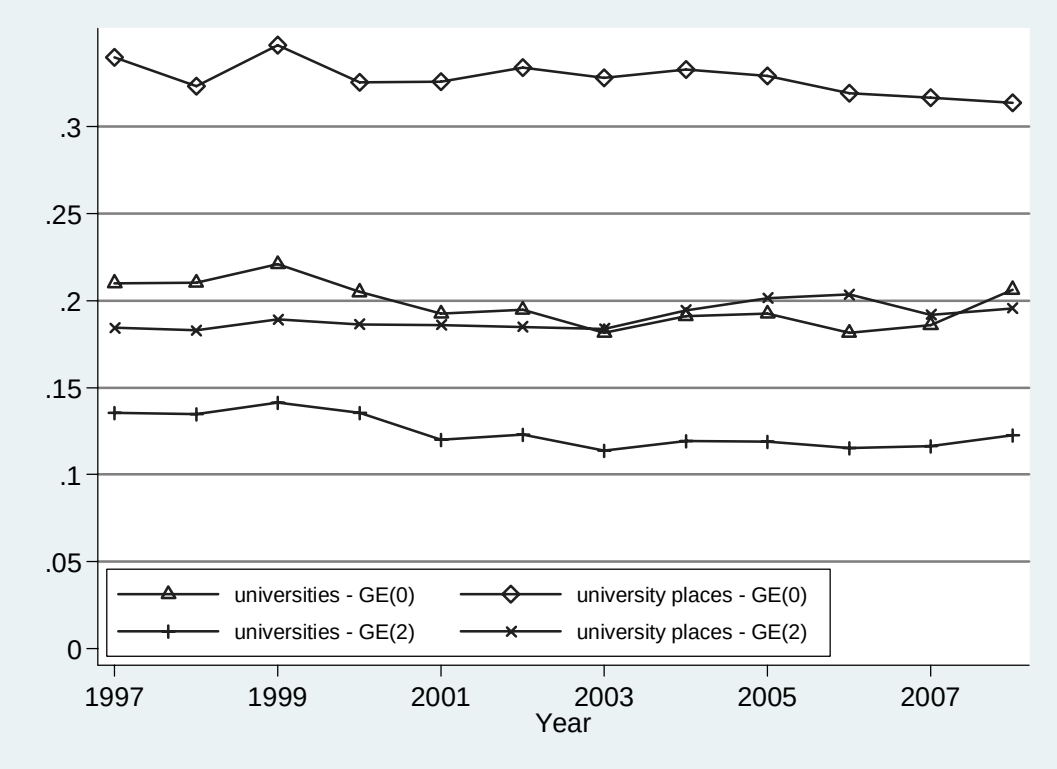
Appendix

Figure A: Inequality in distribution of universities and university places across provinces (unweighted absolute GE(0) index and unweighted absolute GE(2) index)



Sources: MOE(b) (various years). Own calculations.