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## Higher Education Expansion and Supply of Teachers in China

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DISCUSSION PAPER SERIES

IZA DP No. 14825

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NOVEMBER 2021

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# Higher Education Expansion and Supply of Teachers in China

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## ABSTRACT

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# Higher Education Expansion and Supply of Teachers in China\*

We examine the teacher labour market in China using the 2005 mini-Census, in the context of the transformation of the world's largest education system. We first document a significant increase not only in quantity, but also in quality of teachers during 1990-2005. Instrumental Variables results based on the natural experiment of a substantial expansion of higher education in 1992/93 indicate a large positive causal effect of the expansion on supply of teachers. Consistent with differential opportunity costs across graduate occupations, the supply effect is more pronounced for women and those living in less developed regions. Further analyses of differential college premiums in earnings and non-pecuniary benefits between teaching and non-teaching occupations suggest that teacher recruitment has become more market-oriented and flexible, in attracting low to lower-middle ability college graduates into teaching in an increasingly decentralized and competitive graduate labour market.

**JEL Classification:** I23, I26, J45

**Keywords:** higher education expansion, supply of teachers, China, instrumental variables, college premium, non-pecuniary benefits

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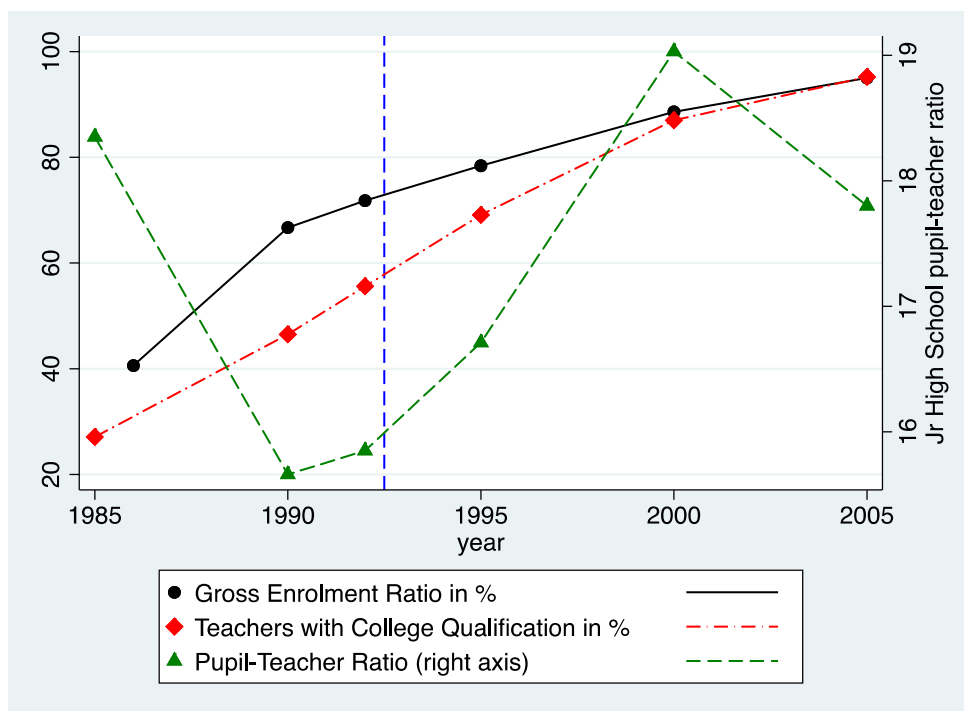
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## 1. Introduction

State schools dominate in K-12 education in most countries, with teacher salaries typically accounting for over 70% of the school budget (OECD, 2005). Given the policy implications on education quality and public finance, teacher supply has been at the centre of education policy research across the world (Dolton, 2006).

As the country which has transformed from being one of the poorest to the second largest economy in the world in just over four decades, China offers a particularly interesting case study. While the overall contribution of human capital to the phenomenal economic development is estimated to be around 40% (Whalley & Zhao, 2010; Li et al., 2017a), the underlying mechanisms are still not well understood.

**Figure 1: Junior High School Trends, 1985-2005**



Note: Authors calculations based on Education Statistical Yearbooks and Statistical Yearbooks of China, various years. The blue vertical dash line marks the beginning of the 1992/93 higher education expansion.

Figure 1 focuses on the remarkable transformation of lower secondary education (junior high schools) in China over the period 1985-2005. When China enacted the nine-year *Compulsory Education Law* in 1986, lower secondary education gross enrolment rate was barely over 40%. However, near universal nine-year education was achieved in 2005, when lower secondary

education gross enrolment rate hit 95%.<sup>1</sup> Over the same period, while the pupil-teacher ratio had been on a declining trend with minor fluctuations, the share of college-educated junior high school teachers more than tripled, from 27.1% to 95.2%. These trends strongly suggest that the evolution of supply of teachers, especially college-educated teachers, could be the key driver underlying the mass transformation of China's secondary education.<sup>2</sup>

The 1990-2005 period can be characterised as the “phase of system restructuring” in terms of teacher education development in China (Rao, 2020), with the introduction of the *Teachers Law* in 1993 and the *Regulations of Teacher Certification* in 1995 which in turn opened up the old teacher preparation education system. In the meantime, the financing of basic education in China has moved away from a centralised system, so that provincial and sub-provincial level governments were made responsible for the administration and funding of schools, to promote competition and better mobilise additional government and non-government resources (Tsang, 1996). Given the remarkable inequality in economic development and stock of human capital across regions and between urban and rural areas in the early 1990s, the policy goal of rapid professionalisation of teachers on the national scale was very challenging.

This paper studies the key role of the teacher labour market in China using the 2005 mini-Census, in the context of the transformation of the world's largest education system. Drawing on aggregate education statistics, we first document a significant increase not only in the quantity, but also in the quality of teachers during the 1990-2005 period. Instrumental Variables (IV) results based on the natural experiment of a substantial HE expansion in 1992/93 indicate that graduates exposed to the expansion had very high propensities, around 27%, to become teachers. Consistent with differential opportunity costs in a quasi-marketized labour market for graduates, the supply effect is found to be more pronounced for women and those living in less developed regions (up to 65%). While there is little evidence of an increase in the college premium for teachers resulting from the HE expansion on average, the findings of differential college premiums in earnings and non-pecuniary benefits

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<sup>1</sup> While China ranked first in all three subjects of the 2018 Programme for International Student Assessment (PISA) on 15-year-olds, the results were based on surveys in the two metropolises of Beijing and Shanghai, and two of the richest provinces, Jiangsu and Zhejiang (OECD, 2019). Nevertheless, it suggests that universal 9-year education was not achieved at the expense of quality.

<sup>2</sup> China's achievement in post-compulsory education, especially higher education (HE), is no less remarkable. In just over two decades, China managed to transit from a highly elitist HE system with less than 5% gross participation rate in 1998 to mass higher education with over 50% gross participation rate in 2020.

between teaching and non-teaching graduate occupations, across such dimensions as gender, region type and the conditional earning distribution, suggest that teacher recruitment has become more market-oriented and flexible, in attracting low to lower-middle ability graduates into teaching, in an increasingly competitive graduate labour market.

This paper makes at least two contributions. First, we document a previously unexplored HE expansion in China in the early 1990s in the context of a mass transformation in secondary education, evidenced by the remarkable increases in both quantity and quality of teachers, over 1990-2005. Second, using the HE expansion in China in the early 1990 as a natural experiment, our IV estimates show a strong positive causal effect of the HE expansion on supply of teachers for college graduates who enrolled in HE only because of the expansion. Our findings indicate that the 1992/93 HE expansion has been instrumental in the substantial growth in the supply of college-educated teachers in an increasingly decentralised graduate labour market. Without this earlier expansion which markedly increased both the quantity and quality of secondary schoolteachers, the subsequent *Great HE Expansion* which increased HE enrolment by 5-fold between 1998 and 2008 could not have been sustained due to the severe bottleneck in the supply of secondary schoolteachers.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 introduces the 1992/93 HE expansion in the context of the transformation of secondary education over 1990-2005, with details on the institutional factors. Section 4 presents the data and summary statistics of the analytical sample. Section 5 outlines the identification strategy based on instrumental variables estimation using the HE expansion as a natural experiment. Section 6 presents the empirical analysis which shows that the HE expansion has a positive causal effect on the supply of teachers, especially for women. This is complemented by analysis of the effect of the HE expansion on the college premiums in earnings and non-pecuniary benefits in explaining the heterogeneous patterns across gender, area type and ability distribution. Finally, Section 7 concludes.

## **2. Literature Review**

The supply of teachers is arguably the most important research question for education economists, due to the enormous implications on public finance and school quality. Dolton (2006) provides a comprehensive overview on the determinants of the various aspects of teacher supply, including recruitment, turnover, and mobility, from an economic perspective. He finds that most published

studies on teacher supply focus on the effect of *relative* salaries on teacher recruitment and retention, typically using graduates in other occupations as a control group, holding constant key characteristics such as age, gender, and birth cohort. For instance, using the American Community Survey for 2009-2011, Rickman, Wang & Winters (2019) show that public teacher salary comparisons across US states should be based on non-teacher college graduates in the states, adjusted for differences in cost of living, federal tax rates and individual characteristics.<sup>3</sup> Indeed, the independent School Teachers' Review Body which advises the UK government on teacher remuneration explicitly states that: “(the objectives of the pay system) must therefore ensure that the earnings for teachers are **competitive with the wider graduate labour market**. The level of starting pay must provide a competitive point of entry to the profession in comparison to other graduate professions within the relevant local labour market (STRB, 2020)”.

The labour markets for state schoolteachers in developed countries tend to be highly regulated due to public financing, with clear entry requirements on educational qualification and national pay scales, often resulting in area- and subject-specific teacher shortages (Dolton, 2006; Sibieta, 2018). With recent advances in data availability and methodology, studies allowing for causal inferences which are important for evidence-based policymaking have been at the frontier of research on teacher supply.

A systematic review of empirical studies involving causal or suitable comparative designs, mostly from the US, conclude that financial incentives were the only way to attract teachers to challenging schools (See et al., 2020). For instance, Clotfelter et al. (2008) show that a bonus scheme for maths, science, and special education teachers in North Carolina, reduced teacher turnover by 5 percentage points, from a baseline of 30%. Using an IV approach, Steele, Murnane & Willett (2010) demonstrate that a competitively allocated incentive scheme has a positive effect of attracting academically talented new teachers to low-performing schools in California. Glazerman et al. (2013) examine the impact of a similar incentive scheme which offered substantial but time-limited bonuses to talented teachers in California to work in low-performing schools. While a positive effect was found on teacher recruitment and retention, the effect did not persist beyond the payout period. Exploring various financial incentive schemes for shortage subject teachers in Florida, Feng & Sass

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<sup>3</sup> Green et al. (2008) show that private schoolteachers in the UK enjoy greater job satisfaction and longer holidays, but earn no more, than their state school counterparts. Moreover, they document a substantial shortage-subject teacher pay premium only for private-school teachers.



(2017) show they reduce attrition rates by about 11%, 9% and 11% for teachers in maths, science, and foreign languages respectively.<sup>4</sup>

Empirical studies for developing countries, where they exist, are predominantly qualitative or descriptive in nature, due to a lack of survey or administrative data.<sup>5</sup> Crawford & Pugatch (2020) review evidence on teacher labour markets in developing countries under a theoretical framework. They highlight spatial inequality and segmentation, between qualified/unqualified and public/private sector teachers, as unique features for the teacher labour market in developing countries. They conclude that significant gaps in understanding still remain, especially regarding evidence on long-term effects of teachers' responses to pay changes, on recruitment of new teachers, or on non-pecuniary compensation.

As far as we are aware, there has been no systematic quantitative study on teacher labour market in China, despite its significance.<sup>6</sup> Nevertheless, it is useful to briefly review the existing descriptive or qualitative studies to better understand the historical backgrounds and institutional features around the transformation of the secondary education sector in the reform era.

The pre-reform socialist labour system under planning in China could be characterised by an institutionalised urban-rural divide through the *hukou* (household registration) system which limits the mobility of rural labour, and offers centralized labour allocation, subsistence wage with non-portable worker benefits (pensions, healthcare, and housing) for urban residents. The highly compressed wage structure set by the central planner according to some national standardized wage scales reflected occupation, industry, ownership, technological level, and above all tenure, rather than individual productivity or the firm's profitability (Knight & Song 2005; Cai et al. 2008).

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<sup>4</sup> Willen (2021) shows that a wage decentralization reform for teachers in Sweden increases teacher wage dispersion across regions but has no impact on the recruitment, retention, composition of teachers, or the outcomes of students, although there is suggestive evidence of a spillover effect to occupations that are close substitutes to teaching.

<sup>5</sup> There are only a few causal studies from developing countries. Using a structural model approach with province dummies as the instrumental variables for occupational choice, Chen (2009) finds that the teacher law in Indonesia which significantly increased pay for college-educated teachers nearly doubled the share of graduates who become teachers from 16% to 30%, at a cost of a 31% increase in the teacher wage bill. Using national administrative data and a regression discontinuity around the teacher screening tests in Colombia, Saavedra et al. (2017) show that novice public schoolteachers enjoy a substantial wage premium.

<sup>6</sup> Li (2017, p138) laments the “dearth of policy studies in China based on empirical approaches” and that “there have been too many sporadic theoretical debates or general discussions on educational policies, little of which have been based on empirical evidence”.

Urban reforms in China started in the early 1980s, following the initial success of rural reforms which greatly increased farm productivity by giving farmers autonomy over production and the residual claims of profits. This resulted in substantial increase in surplus labour and rapid growth of the collectively owned township and village enterprises (TVEs). Responding to the growing competition from TVEs, the government started to reform the state-owned enterprises (SOEs) which were the dominant employers in urban areas (Cai, Park & Zhao, 2008).

In the following decades, the Chinese labour market has been undergoing remarkable transformations, through improving labour mobility, increasing managerial autonomy and incentives, profit sharing, privatisation of small and medium SOEs, and introducing labour contracts, social insurance, pension and housing reforms etc., despite remaining barriers (Knight & Song, 2005; Cai, Park & Zhao, 2008; Meng 2012). As the labour market becomes increasingly decentralized and marketized, the returns to education, especially HE, increased significantly starting in the mid-1990s (Zhang et al. 2005; Zhang & Zhao 2007; Li et al. 2017a).

A recent meta-analysis concludes that the returns to education in China in the post-reform era are around 18% per annum, with higher returns to college degrees than lower levels of education (Awaworyi & Mishra, 2018). However, most of the studies covered cannot be interpreted as causal. Using different data sources and various quasi-experimental methods, more recent research exploring the *Great HE Expansion* starting in 1999 as a natural experiment suggest that causal returns to higher education stand at around 9-24% per annum, (see Wu & Zhao, 2010; Li et al., 2017b; Dai, Cai & Zhu, 2021; Huang et al., 2021). These findings, albeit based on a slightly later HE expansion, suggest that the cohorts of college and university graduates who were exposed to the 1992/93 HE expansion, would face an increasingly decentralized and marketized labour market with rising demand for skilled labour upon graduation from the mid-1990s onwards, consistent with *skilled-biased technical change* arising from the restructuring of the economy (Cai, Park & Zhao, 2008). While the buoyant graduate labour market till the onset of the Great Recession in 2007 would favour new graduates, it posed severe challenges to the government's ambition of mass upgrading of schoolteacher quality through the recruitment of college-educated teachers.

### **3. The 1992/93 HE expansion and transformation of secondary education**

#### *3.1. Introduction of Nine-year Compulsory Education and Reform of the Educational System*

China formally introduced nine-year compulsory education in 1986, which comprises six years of primary schools and three years of junior high schools. This was a very ambitious plan at a time when the gross enrolment ratio for lower-secondary schools was only 40.6%, and only 62.8% and 27.1% of primary and lower-secondary schoolteachers had the required 12 and 14 years of education respectively (Tsang, 1996).<sup>7</sup>

Under the highly centralized political system and planned economy, the hierarchical and monopolised system of *normal* (*shifan*) schools, teacher colleges and normal universities were exclusively responsible for the training of K-12 schoolteachers (Zhou & Reed 2005; Zhu & Han 2006).<sup>8</sup> Student admission and graduate assignment of these teacher training institutions were largely location-oriented to satisfy the need for basic education within their local areas. As graduates assigned to public sector jobs, the salaries of new teachers were centrally set by the Central Planning Commission (Meng, 2012). However, due to the low social status and living conditions of teachers, teacher education students came disproportionately from relatively lower part of the ability distribution and lower income families, especially for males and poorer remote regions (Zhou & Reed, 2005).

In 1985, the central government announced the reform of the education system, covering both education governance and education management (Fan & Zhang, 2020). As part of the wider public finance reform to facilitate the transition from central planning to a socialist market economy, the financing of education in China had also been decentralized and diversified. Under the principle of “local responsibility and administration by levels”, the provision and financing of primary and secondary education became the responsibility of provincial and sub-provincial governments, to mobilize additional government and non-government resources when basic education was severely under-funded by the central government (Tsang, 1996). However, with substantial and growing inequality in revenue raising capacities, an increase in teachers’ pay inequality across the country is almost inevitable. On the other hand, the growing competition and flexibility in the quasi-

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<sup>7</sup> By 1990, *minban* (non-government) teachers still accounted for 41% and 10% of all full-time primary- and junior high schoolteachers respectively. They received living subsidies funded by village community education surcharges and levies instead of salaries and were disproportionately under-qualified and employed in poor rural areas (Tsang, 1996).

<sup>8</sup> The term *normal* originated from the French term *école normale*.

marketized teacher labour market also enabled local education authorities to attract new college graduates into teaching through pay and non-pecuniary benefits in the post-expansion era.

Having reviewed evidence from developing countries on strategies to recruit qualified teachers, often under severe budget constraint and limited teacher training capacity, Vegas (2007) concludes that school-based management reforms which decentralizes decision making power are promising in reducing teacher absenteeism and increasing teacher working hours and effort. There are two basic models of teacher employment in the public sector (OECD, 2005). The career-based system which relies on centralized academic credentials and entry examinations tends to reduce inequality but does not respond well to diverse local needs. On the other hand, the position-based system allows personnel selection and management to be decentralised to schools or local education authorities. In many respects, China's emerging teacher labour market represents a shift away from the career-based system to a position-based one.

The market-oriented reforms of the educational system failed to recruit and retain high quality teachers initially, as evidenced by the mass resignations and suspensions without pay of teachers (Ren, 2019). To reverse the trend, China introduced the *Teachers Law* in 1993 which mandates that the average salary level of teachers should be no lower than their civil servant counterparts. While the law encouraged graduates from non-teacher training institutions to teach in primary and secondary schools (Zhou & Reed, 2005), it introduced professional licensing for all teachers, with specific minimum requirements on educational qualifications: normal school, 3-year (teacher) college and 4-year (normal) university degree qualifications for primary, junior high and senior high school teachers, respectively (Rao, 2020). Further government regulations and policies were implemented subsequently to strengthen quality assurance mechanisms in the teaching profession with detailed targets and requirements on local governments to improve teacher salaries and living conditions, which was benchmarked against those of civil servants (Zhou & Reed, 2005).

With the introduction of tuition fees across most HE institutions except for teacher training institutions in 1996, the government also stopped assigning college graduates to public sector jobs.<sup>9</sup> As a result, the matching of new college graduates to jobs was left to the labour market.<sup>10</sup> Given the job security and access to urban *hukou* in the city of employment, teaching might become more

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<sup>9</sup> <http://edu.163.com/special/gaokao/xf.html>.

<sup>10</sup> <http://www.lscps.gov.cn/html/13239>.

attractive to graduates conditional on pay, especially for the *regular (bianzhi) teachers* on permanent contracts who largely enjoy similar status to that of local civil servants according to the 1993 *Teachers Law*.<sup>11</sup>

### 3.2. The 1992/93 HE Expansion

A burgeoning literature has taken advantage of both the 1986 *Compulsory Education Law* and the *Great HE Expansion* starting in 1999 to identify the causal effect of education on employment, earnings, and other outcomes (Li et al., 2017b; Dai, Cai & Zhu, 2021). However, the 1992/93 HE expansion seems to have been largely overlooked by researchers. In this paper, we will examine the role this relatively moderate expansion plays in achieving near universal nine-year compulsory education and facilitating the subsequent massification of HE education, in the context of supply of college-educated secondary schoolteachers.

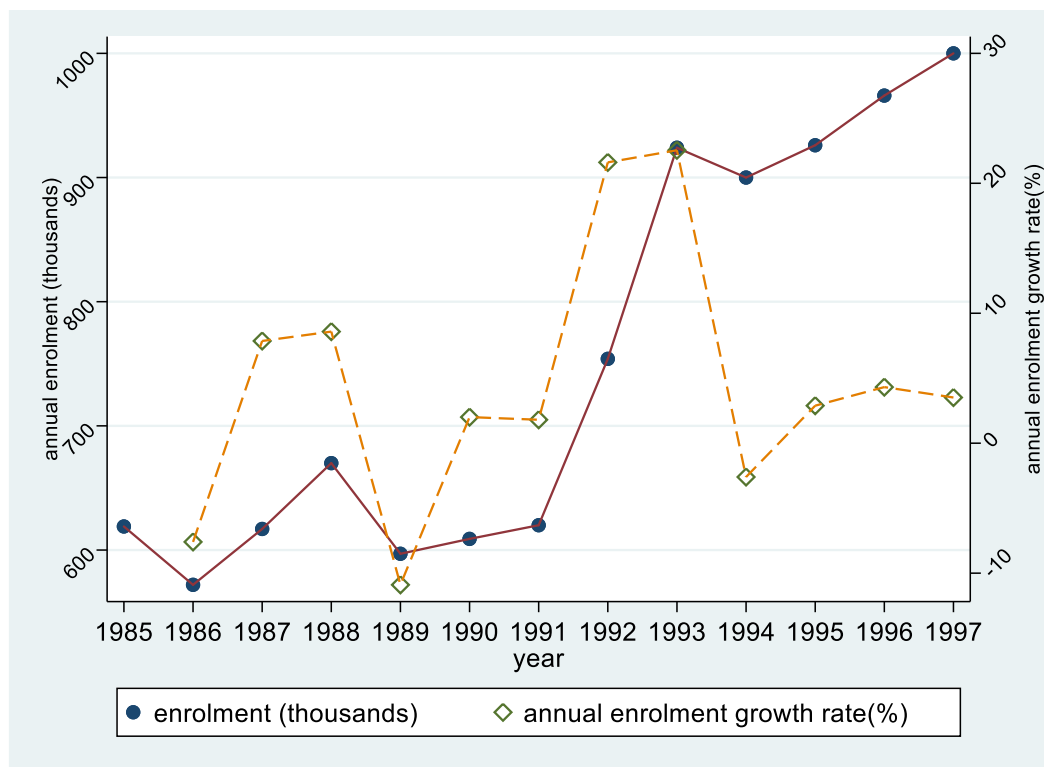
Higher Education in China was heavily regulated under central planning up to the early 1990s. At the time, virtually all universities and college were public funded, with no tuition fee charges. Upon graduation, students were assigned jobs in the public sector by the government. Every year the Ministry of Education issued admissions quotas to each HE institution. Student with senior high school qualifications (or equivalent) compete fiercely for HE places on the basis of their scores in the National University and College Entrance Exams (*gaokao*) after submitting their preferences of degree courses (OECD, 2016).

Figure 2 shows the annual HE enrolment (left scale) growth rates (right scale) over the period 1985-1997. Between 1986 and 1991, annual HE enrolment fluctuated around 600 thousand, representing only around 2.5% of each birth cohort which has around 25 million births. This implies that HE was highly elitist with large excess demand.

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<sup>11</sup> Using a discontinuity in the minimum floor area that would allow house purchases to acquire urban *hukou*, Chen, Shi & Tang (2019) show that the value of urban *hukou* in Jinan City, a provincial capital in the Eastern Region, was about 90-126k yuan, roughly twice the annual salary for new graduates in 2017.

**Figure 2: Annual Higher Education Enrolment and Growth Rates, 1985-1997**



Source: China Statistical Yearbook (NBS, various years).

Following Deng Xiaoping's "Southern tour speech" in the Spring of 1992, the 14<sup>th</sup> Congress of the Chinese Communist Party and its subsequent Central Committee Plenary Meetings announced in late 1992 the historical resolution to work towards establishing "a socialist market economy". Inspired by this new momentum of accelerating reforms, the annual HE enrolment grew by more than 20% in both 1992 and 1993 (Cai, 2011). Following two years of rapid expansion with a total growth of 49% relative to 1991, Chinese HE entered a period of structure adjustment in the period 1994-1997, with only modest growth in enrolment until 1999, when the better known *Great HE Expansion* began.

As a background of the 1992/93 HE expansion, Table 1 shows the trend in key primary and secondary education indicators for 1990-2005, at 5-year intervals. The last column focuses on the growth rates between 1995-2005, as the first graduates from the 1992/93 expansion did not enter the labour market until 1995, after completing 3-year vocational college.

**Table 1: Trend in Primary and Secondary Education, 1990-2005**

	1990	1995	2000	2005	% change 1995-2005
<b>Primary Schools:</b>					
Number of students (million)	122.41	131.95	130.13	108.64	-17.67
Gross enrolment rate (%)	97.8	98.5	99.1	99.2	0.71
Number of full-time teachers (million)	5.58	5.66	5.86	5.59	-1.26
Pupil-teacher ratio	21.93	23.30	22.21	19.43	-16.61
Teachers with required qualifications (%)	73.9	88.9	96.9	98.6	10.91
<b>Junior High Schools:</b>					
Number of students (million)	38.69	47.28	62.56	62.15	31.46
Gross enrolment rate (%)	66.7	78.4	88.6	95.0	21.17
Number of full-time teachers (million)	2.47	2.83	3.29	3.49	23.44
Pupil-teacher ratio	15.66	16.71	19.03	17.80	6.52
Teachers with required qualifications (%)	46.5	69.1	87.0	95.2	37.77
<b>Senior High Schools:</b>					
Number of students (million)	7.17	7.14	12.01	24.09	237.52
Gross enrolment rate (%)	21.6	28.8	38.2	52.7	82.99
Number of full-time teachers (million)	0.562	0.551	0.757	1.300	136.05
Pupil-teacher ratio	12.76	12.97	15.87	18.54	42.95
Teachers with required qualifications (%)	45.5	55.2	68.4	83.5	51.26

Source: Ministry of Education (1990, 1995, 2000 and 2005). Gross enrolment ratios are derived as the share of age-relevant population enrolling in the respectively level of education. The (minimum) required qualifications for primary, junior high and senior high school teachers are normal school, vocational (teacher) college and 4-year (normal) university degrees, respectively.

As measured by the gross enrolment ratio, China has largely achieved universal primary education by 1990. The number of primary school students peaked at around 132 million in 1995, before quickly declining in the early 2000s due to China's family planning policy strictly enforced since 1980. The number of primary schoolteachers remained relatively stable, peaking at 5.86 million in 2000. This enabled a 16.6% decrease in the student-teacher ratio over 1995-2005. A more remarkable change is the rapid improvement in teacher quality, as the share of teachers with the required minimum normal school qualification (nominally equivalent to senior high school) increased from 73.9% to 98.6% over 1990-2005. While most of the credential upgrading occurred in the first five years, the more modest 9.7 percentage points (or 10.9%) increase during 1995-2005 might mask the increasing qualification requirement beyond the legal minimum in more economically developed regions.<sup>12</sup>

On the other hand, near universal lower secondary education was not achieved until 2005, when the junior high school gross enrolment rate hit 95%, almost 20 years after the introduction of 9-year

<sup>12</sup> As increasing share of teachers come from non-normal institutions, the number of normal schools and teacher colleges in China decreased by 72.0% and 58.6% respectively, while the number of 4-year normal universities increased by 10.3%, between 1999 and 2005 (Ministry of Education, 2010).

compulsory education in 1986. To accommodate the increase in student numbers, the number of full-time junior high school teachers increased from 2.47 million in 1990, to 2.83 million in 1995, before reaching 3.49 million in 2005. This represents a 23.4% growth over 1995-2005, reflecting strong demand driven by increasing student numbers. Indeed, the pupil-teacher ratio peaked at 19.03 in 2000, before falling back to 17.80 in 2005. Moreover, the share of junior high school teachers with the required vocational (teacher) college qualifications more than doubled, from 46.5% to 95.2%, during 1990-2005, with the last 10 years accounting for over half of the improvement.

The growth of the senior high school sector did not take off until 1995. If anything, there was a slight decline in both student and teacher numbers in senior high schools during 1990-1995, although the proportion of senior high school teachers with the required university degree qualifications increased from 45.5% to 55.2%, a 21.3% growth. In the following decade, the number of senior high school students and teachers increased by 237.5% and 136.1% respectively, with accelerating growth in the period 2000-2005.<sup>13</sup> Consequently, the pupil-teacher ratio reached an all-time high of 18.54 in 2005. What makes this growth even more remarkable is the 28.3 percentage points (or 51.3%) increase in the share of senior high school teachers achieving the required 4-year degree qualifications over the same decade.

Overall, the number of full-time junior and senior high school teachers increased by 0.66 million and 0.75 million respectively during 1995-2005. Given the new minimum qualification standards for secondary schoolteachers mandated by the 1993 *Teachers Law*, one would expect that the vast majority of the 1.41 million extra teachers to be new college or university graduates.

Under reasonable assumptions of replacement of retired teachers (say one-third of the 1995 stock of secondary schoolteachers, i.e.  $3.38/3=1.13$  million, assuming a 30-year career), a ballpark figure for teacher demand in the decade 1995-2005 would be around 2.5 million, or 0.25 million per year. Moreover, a simple back-of-the envelop calculation indicates all post-1995 new entrants plus the replacement appointments would need to satisfy the minimum qualification to be consistent with the observed surge in the share of junior high school teachers with the required qualifications.<sup>14</sup> This

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<sup>13</sup> The *Great HE Expansion* starting in 1999 might have induced a spillover effect on demand for senior high school places (Dai, Cai & Zhu, 2021). However, we do not expect this to have a significant impact for our analysis given that our sample members born between 1968-1977 would be too old for the later expansion.

<sup>14</sup> For senior high school teachers, we would over-predict the share of qualified teachers with a university degree by 4 percentage points compared to the actual share of 83.5% in 2005. The difference between junior and senior high schools



obviously poses a real challenge when the annual HE enrolment was only about 0.924 million even after the 49% expansion between 1991 and 1993.

## 4. Data and Sample

### 4.1. Data

This paper is based on the 2005 mini-Census of China, formally known as the 2005 One-percent Population Survey of China, conducted by the National Bureau of Statistics (NBS) on the Census date of 1<sup>st</sup> of November 2005. Using a stratified multi-stage proportional sampling, the survey accounts for 1.31% of the population. Our study is based on a 20% random subsample, with more than 2.5 million individuals.<sup>15</sup>

Teachers can be identified from the occupation question in the mini-Census. While it is impossible to distinguish between primary, junior high and senior high school teachers, we can be quite confident that the vast majority of teachers with college or university qualifications are secondary schoolteachers, on the ground that that only normal school diploma, which is nominally equivalent to Senior High School qualification, is required for primary schools.

Admittedly, the cross-section nature of the mini-Census is a limitation. However, we believe that occupation observed in the age range 27-36 in our sample gives a very good indication of the impact of the HE expansion of the occupational choice of graduates. After 1996, graduates in general are no longer assigned to jobs by the government. The job security offered by teaching, as well as the eligibility for a local *hukou*, are often regarded as the main attractions of teaching. Moreover, Inter-province migration is rare even among graduates, as just only 2.83% graduates in our analytical sample report a province of residence different from the province of the *hukou* registration. In the empirical analysis we control for province fixed-effects throughout, to capture unobservable time-invariant local labour market conditions (Dahl, 2002).

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likely reflects both the higher qualification requirement and the surge in demand which is harder to meet by the limited supply in the short run for the latter.

<sup>15</sup> The 2005 mini-Census is the most suitable year of census to study the transformation of the labour market of secondary school teachers in China. Earlier census years would miss out a substantial part of the expansion of the secondary school sector, especially for senior high schools, as suggested by Table 1. On the other hand, later censuses might confound the effect of HE expansions from those of other educational reforms, such as the 2006 free compulsory education reform mostly impacting rural children and the 2008 reform that exempted migrant children from tuition and miscellaneous fees charged by urban public schools (see Tani, Xu & Zhu, 2021).

## 4.2. Sample

Our analytical sample consists of nearly 373 thousand individuals, who were born within 60 months on either side of September 1973, the age cut-off induced by the 1992/93 HE expansion. In line with studies on the 1999 HE expansion suggesting age 19 as the optimal threshold for pre- and post-expansion birth cohort (Dai, Cai & Zhu, 2021), this sample includes 10 birth cohorts, of which half were exposed to the HE expansion. Note that we choose not to include people born in Sept 1978 or later, as they might be affected by the even more remarkable *Great HE Expansion* starting in 1999.

We are effectively comparing graduates and teachers aged 27-31 in 2005, who were exposed to the 1992/93 HE expansion, to their older counterparts who were aged 32-36 and not exposed to the same HE expansion. The age range of these 10 birth cohorts is 27-36 at the time of the 2005 mini-Census, thus enables reliable measure of mid-career incomes, well beyond any probation period even for university graduates who are expected to enter the labour market around age 22-23. Compared to the typical focus in the literature on the effects of incentive schemes to attract new teachers over a couple of years, the “medium-term” labour supply effect identified is less prone to noises at the beginning of the career, as most teacher attritions occur in the first few years.

Table A1 in the Appendix compares teachers to non-teachers in both the full analytical sample and the subsample of respondents with college or higher qualifications. Among the full sample, 81% of teachers are college educated, of which 43% (i.e. 35% out of 81%) hold 4-year university degrees.<sup>16</sup> This compares favourably to the 9% of the college-educated in other occupations. Among the college-educated, teachers are still more likely to hold university degrees than their non-teacher counterparts, but much more likely to be females.

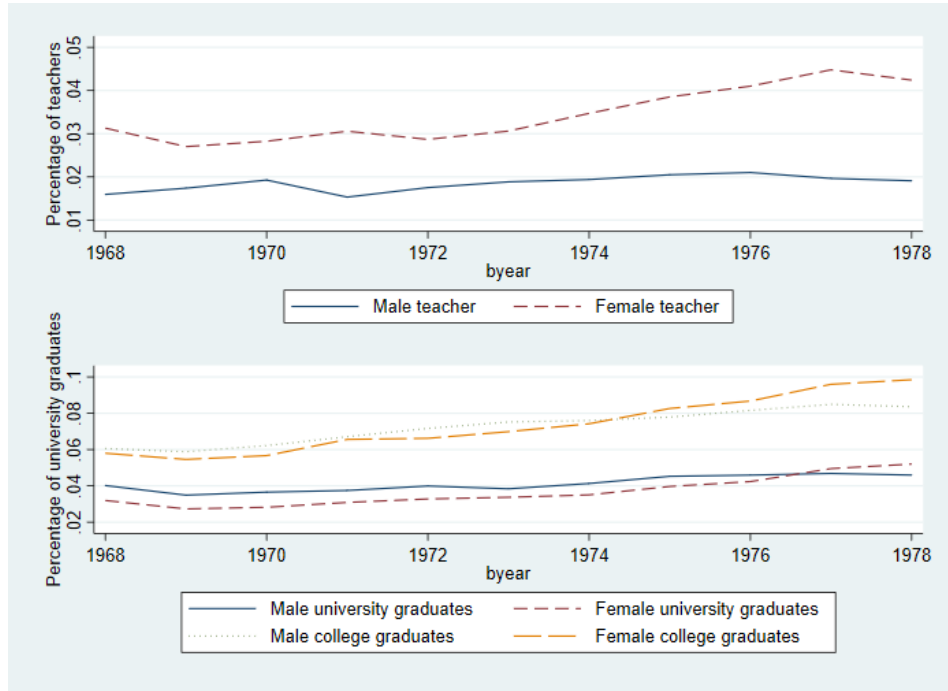
The upper panel of Figure 3 shows that the incidence of being a teacher for women increases for younger cohorts while that for men remains largely constant for the range of birth cohorts in the analytical sample. As a result, the gender gap in favour of women in teaching has widened significantly for younger graduates. On the other hand, the lower panel indicates that the shares of both college and university graduates have increased after the HE expansion, with larger increases for vocational college graduates. Moreover, the gender gap in HE attainment in favour of men seems to be reversed for post-1977 birth cohorts, especially for those attending vocational colleges. These

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<sup>16</sup> We have excluded the small number of respondents who hold any postgraduate qualifications to avoid misclassifying teachers of HE institutions (which require higher degrees) as K-12 schoolteachers.

trends provide a useful indication on how the potential labour supply of college-educated teachers has evolved as a result of the 1992/93 HE expansion.

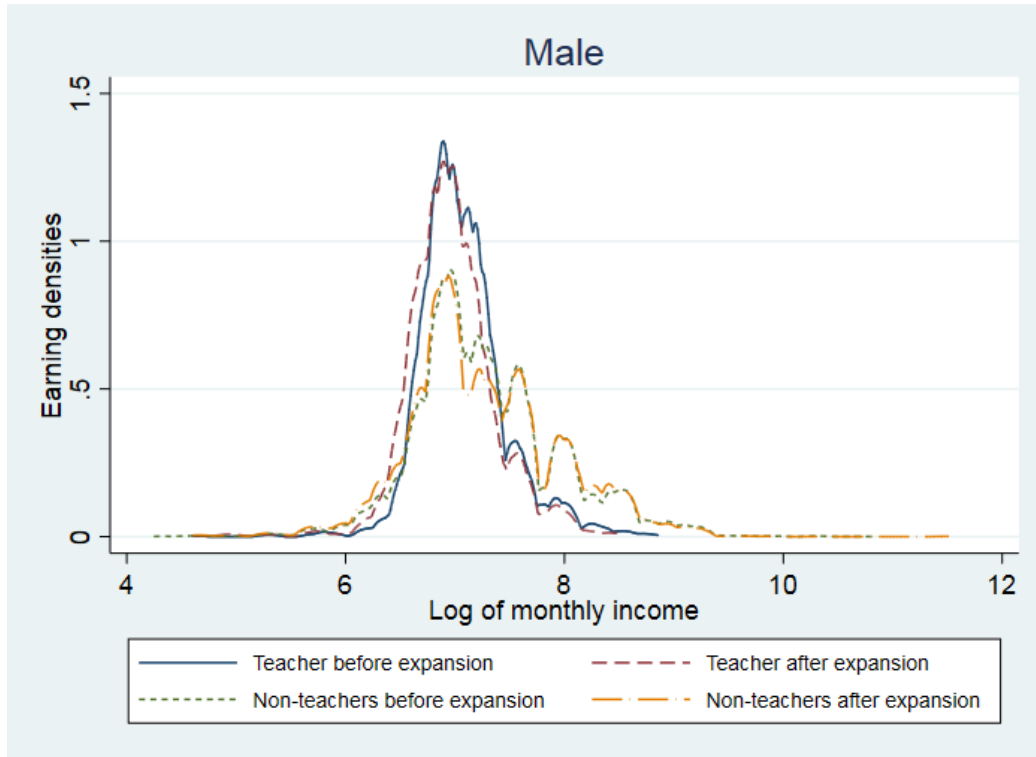
**Figure 3: Gender-specific shares of teachers and college/university graduates, by birth cohorts**



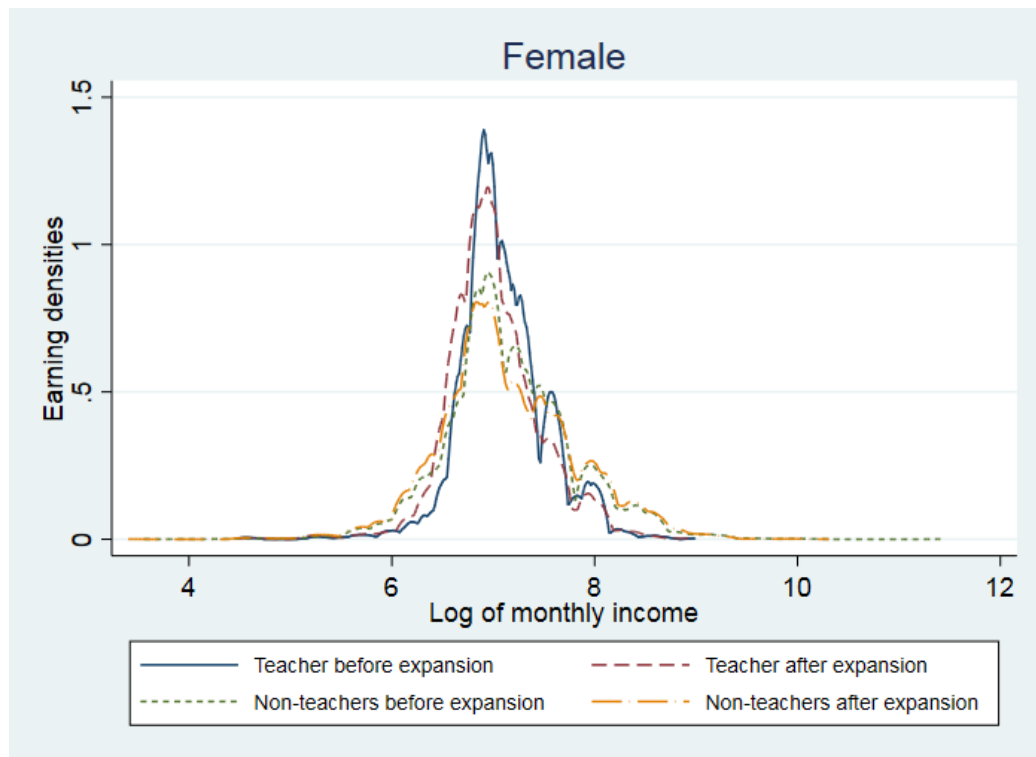
Note: The upper panel shows gender-specific share of teachers in percentages by birth cohorts. The bottom panel show the gender-specific shares of college and university graduates by birth cohorts.

Following the wider literature on teacher labour supply, we compare earnings of college-educated teachers (i.e. teachers with HE qualifications) to those of non-teacher graduates. Figure 4A and 4B compare the changes in the kernel densities of log monthly incomes due to the 1992/93 HE expansion for teacher vs. non-teacher graduates, by gender. As expected, the incomes of non-teacher graduates are less compressed and more right skewed compared to their teacher counterparts, regardless of gender. Moreover, non-teacher graduates only suffer very modest drops in earnings post-expansion relative to their pre-expansion counterparts, despite having five-years less working experience on average. On the other hand, the gap in earnings between pre- and post-expansion college-educated teachers are more substantial.

**Figure 4A: Log monthly income distribution for HE graduates, Males**



**Figure 4B: Log monthly income distribution for HE graduates, Females**



## 5. Identification Strategy

Our identification relies on an IV strategy, using the 1992/93 HE expansion as a natural experiment. It is similar in spirit to that used by Li et al. (2017b) to analyse the effect of the *Great HE Expansion* in China starting from 1999. The idea is to construct an IV for HE expansion in province  $p$  in year  $t$  as the natural logarithm of the sum of potential college enrolment expansion for all post-expansion cohorts  $t$  ( $t = 1992, 1993, \dots, 1996$ ):

$$\ln(Expansion_{p,t}) = \ln(TotalExpansion_t \times EnrolmentShare_{p,base}) \quad (1)$$

where  $Total\ Expansion_t$  is the national HE enrolment in year  $t$  in excess of the average national enrolment in the baseline period (1989-1991), and  $Enrolment\ Share_{p,base}$  is the average provincial share in the baseline period.<sup>17</sup>

To overcome the potential endogeneity of actual HE enrolment expansion due to anticipated future demand for skilled labour, potential expansion is used instead. The underlying assumption is that potential HE enrolment is determined by each province's predetermined enrolment capacity.

Under the system of central planning, both pre-expansion provincial enrolment shares and the annual rate of enrolment expansion at the national level are exogenous. Therefore, the IV based on the product of the two terms must also be exogenous.<sup>18</sup>

Equation (2) forms the first stage of the Two Stage Least Squares (2SLS) estimation, which estimates the propensity of HE enrolment,  $Graduate_{i,p}$ , for respondent  $i$  in province  $p$ , using the cohort-specific IVs as well as exogenous control variables  $X_{i,p}$ , allowing for a set of province fixed-effects,  $D$ . In the second stage, we regress the dummy variable for being a teacher on the predicted probability of being a college graduate from the first stage,  $X_{i,p}$  and  $D$ :

First stage:

$$Graduate_{i,p} = \beta_1 \ln(Expansion_{p,t}) + X_{i,p}\gamma_1 + D\delta_1 + \mu_{i,p} \quad (2)$$

Second stage:

$$Teacher_{i,p} = \beta_2 \widehat{Graduate}_{p,t} + X_{i,p}\gamma_2 + D\delta_2 + \varepsilon_{i,p} \quad (3)$$

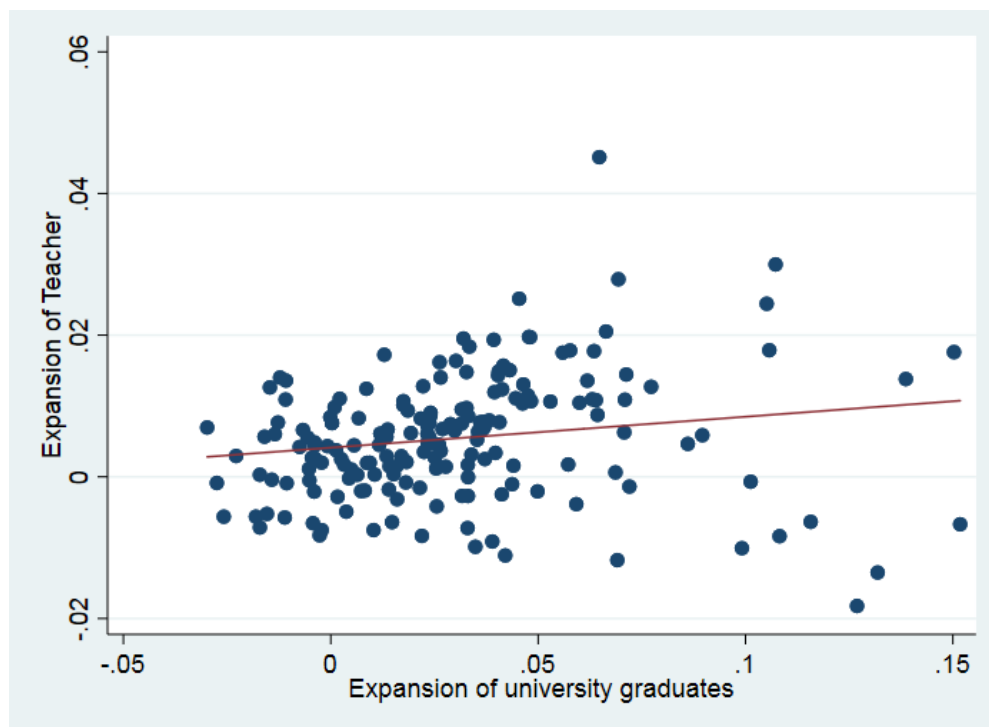
<sup>17</sup>  $Total\ Expansion_t = National\ Enrolment_t - (\sum_{1989}^{1991} National\ Enrolment_s)/3$ .

<sup>18</sup> The gap between enrolment and graduation rates are very small in Chinese HE. While official statistics are not available, our imputed HE attrition rates, using HE graduation numbers and lagged enrolments from the Education Statistical Yearbooks, ranged from 0.37% to 0.64% during the period 1990-1997.

Note that the parameter of interest  $\beta_2$  has the interpretation of a local average treatment effect (LATE), i.e. the probability of choosing teaching for a graduate who enrolled in HE only as a result of the expansion.

Figure 5 shows that there is a statistically positive relationship between the percentage change in HE enrolment and the percentage increase in teacher numbers at the province-cohort level.<sup>19</sup> A positive fitted line provides *prima facie* evidence of a positive relationship between HE enrolment and the supply of secondary schoolteachers within province in each year.

**Figure 5: Relationship between the HE expansion and numbers of teachers**



Notes: Each data point represents one province-specific post-expansion birth cohort. The horizontal axis measures expansion rates in annual HE enrolment. The vertical axis measures the corresponding growth in the number of teachers. The straight line fitting unweighted OLS has a slope of 0.120 (SE=0.019), with  $R^2=0.18$ .

<sup>19</sup> Appendix Figure A1 shows that the share of HE graduates aged 25-60 varies substantially across provinces, reflecting the spatial variation in economic development, stock of human capital and concentration of educational resources.

## 6. Empirical results

We first present the causal evidence on the effect of the 1992/93 HE expansion on the overall supply of teachers, using the IV approach outlined in the previous section. This is then followed by further analysis of differential graduate premiums in earnings and non-pecuniary benefits to shed light on possible mechanisms of graduate career choice and heterogeneous effect of the HE expansion by gender, area type and ability.

**Table 2: 2SLS estimates of HE qualification on teaching, pooled and by gender**

	Pooled gender	Male	Female
<b>Second-stage (dep variable: Teacher):</b>			
HE qualification	0.2698*** (0.0452)	0.1982*** (0.0488)	0.3898*** (0.0842)
Male	-0.0151*** (0.0005)	-	-
Age	-0.0057*** (0.0021)	-0.0025 (0.0025)	-0.0080** (0.0037)
Age squared	0.0001*** (0.0000)	0.0000 (0.0000)	0.0001** (0.0001)
Han ethnicity	-0.0082*** (0.0016)	-0.0083*** (0.0018)	-0.0091*** (0.0029)
Married	0.0188*** (0.0027)	0.0109*** (0.0017)	0.0566*** (0.0128)
Remarried	0.0208*** (0.0053)	0.0132*** (0.0047)	0.0623*** (0.0175)
Divorced	0.0152*** (0.0034)	0.0109*** (0.0041)	0.0365*** (0.0090)
Widowed	0.0215*** (0.0062)	0.0109 (0.0073)	0.0612*** (0.0164)
Province fixed-effects	✓	✓	✓
Constant	0.0241 (0.0446)	-0.0217 (0.0435)	-0.0149 (0.0968)
<b>First-stage (dep variable: HE qualification):</b>			
Instrumental variables (excluded from 2 <sup>nd</sup> - stage)			
HE expansion 92	0.0019*** (0.0003)	0.0022*** (0.0004)	0.0015*** (0.0004)
HE expansion 93	0.0030*** (0.0004)	0.0035*** (0.0005)	0.0025*** (0.0005)
HE expansion 94	0.0046*** (0.0005)	0.0050*** (0.0007)	0.0041*** (0.0007)
HE expansion 95	0.0069*** (0.0006)	0.0076*** (0.0009)	0.0061*** (0.0009)
HE expansion 96	0.0084*** (0.0009)	0.0093*** (0.0012)	0.0072*** (0.0012)
<b>Diagnostic Tests:</b>			
F-statistic	65.50	8.682	50.50
Under-identification	116.8	72.18	46.03
Weak Identification	23.36	14.55	9.207
Sargan Test (p-value)	0.238	0.786	0.176
Observations	372,940	197,566	175,374

Note: Standard errors in parentheses. \*:  $p < 0.05$ , \*\*:  $p < 0.01$ , \*\*\*:  $p < 0.001$ . Other ethnicities and never married are omitted categories. The null hypotheses for the Under-identification and the Weak Identification tests are that the model is under-identified and instruments are weak respectively. The null hypothesis for the Sargan-Test is that all instruments are exogenous.

Table 2 presents 2SLS estimates of the effect of HE on the incidence of becoming a teacher, using the cohort-province specific potential HE expansion as instruments (as explained in Section 5), for men and women pooled together and separately. For the pooled gender specification, the probabilities of getting an HE qualification between 1992-1996 in the first stage are increased by 0.19-0.84 percentage points for a doubling of the cohort-province specific potential expansion with each instrument individually highly significant and growing over time due to the accumulated effect. For young graduates who are induced to participate in HE as a result of the expansion only, the chances of choosing teaching increases by 27.0 percentage points in the second stage.<sup>20</sup> While the first stage estimates for men are about 25-50% higher than their female counterparts, the second stage effect on the propensity of being a teacher for male graduates is only half as much as that for female graduates, at 19.8 and 39.0 percentage points respectively. The finding of a strongly gendered pattern of graduate selection into teaching is consistent with both the aggregate trend in Figure 3 and the existing literature on teacher supply (Joy, 2006; Carroll, Parasnis & Tani, 2021).

All 2SLS model specifications pass the usual diagnostic tests for IV relevance and exogeneity, except for the F-statistic for men which is just below the normal threshold of 10. Our results are also highly robust to using the level of potential HE expansion instead of its logarithmic transformation as the IV.

It is worth emphasizing that our 2SLS estimates should be interpreted as a Local Average Treatment Effect (LATE), i.e. the effect of HE on the supply of teachers for **marginal graduates**, i.e. those who would not have enrolled in HE in the absence of the expansion. Our results suggest that the 1992/93 HE expansion induced 27% (or 20% of male and 39% of female) of marginal HE graduates into teaching. This implies that of the about 300k per annum increase in HE enrolment during 1992-1996, around 80k graduates became teachers by 2005.

Figure A2 in the Appendix shows the share of teachers among HE graduates by birth cohort and gender. For both genders, there is a downward trend for pre-expansion cohorts, especially for women. For the youngest pre-expansion birth cohort who were born in 1972, only about 13% of

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<sup>20</sup> Results are robust to an alternative specification using total excess expansion between 1992-1996 as instrument.



male and 23% of female graduates become teachers. After the HE expansion, the trend was reversed for both genders, at least for the first three cohorts. It is now clear that without the much higher marginal propensity to enter teaching for the post-expansion graduates, a severe shortage in teachers would render the substantial increase in junior and senior high school students impossible, let alone raising the quality of teachers at the same time.<sup>21</sup>

However, one should not attempt to generalise the finding to the post-sample periods which cover graduates exposed to the *Great HE Expansion* starting in 1999. Indeed, as structural teacher oversupply emerged after 2005, the policy focus has gradually shifted to enhancing teacher professionalism (Rao, 2020).

Table 3 presents the corresponding 2SLS results by prefectural city level average salary within-province in 2005 (NBS, 2006).<sup>22</sup> For men, the 2SLS estimate is statistically insignificant for areas with above-median salary levels in each province, while it is a highly significant 35.5% for below-median salary areas. For women, the 2SLS estimates are also statistically insignificant in high salary areas, but a highly significant 62.9% in low salary areas. This suggests that teaching is a much more attractive occupation in less developed areas, for both genders. In the lower panel of Table 3, we test the robustness of the results with respect to restricting the sample to respondents with at least a junior high school qualification. The large positive effect of the HE expansion on teacher supply turn out be highly robust, and slightly more pronounced.

Table 4 presents the Ordinary Least Squares (OLS) earnings equation results, by gender and whether restricting the sample to those with at least junior high school qualifications. The model specification is flexible in the sense of allowing full interactions between indicators for HE qualification, post-expansion and being a teacher.

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<sup>21</sup> Chen (2009) shows that a substantial pay increase for college-educated teachers nearly doubled the share of graduates entering teaching in Indonesia from 16% to 30%, at a cost of a 31% increase in the teacher wage bill. This could be a possible scenario for China in the absence of the HE expansion. However, the financial cost would have been significantly higher due to the buoyant graduate labour market with rising returns to HE education.

<sup>22</sup> Appendix Figure A3 shows the box plots of mean salaries across prefecture-cities within province.

**Table 3: 2SLS estimates of HE qualification on teaching by city-level average salary**

Dependent variable (Teacher)	Male		Female	
	Low salary areas (1)	High salary areas (2)	Low salary areas (3)	High salary areas (4)
<b>Full sample:</b>				
HE qualification	0.3552** (0.0758)	0.0246 (0.0756)	0.6285*** (0.1327)	0.2156 (0.1319)
<i>N</i>	89,767	85,558	82,947	72,961
<b>Subsample with at least junior high school qualification:</b>				
HE qualification	0.3606** (0.0812)	0.0300 (0.0834)	0.6524*** (0.1525)	0.2178 (0.1551)
<i>N</i>	71,200	72,383	54,595	55,328

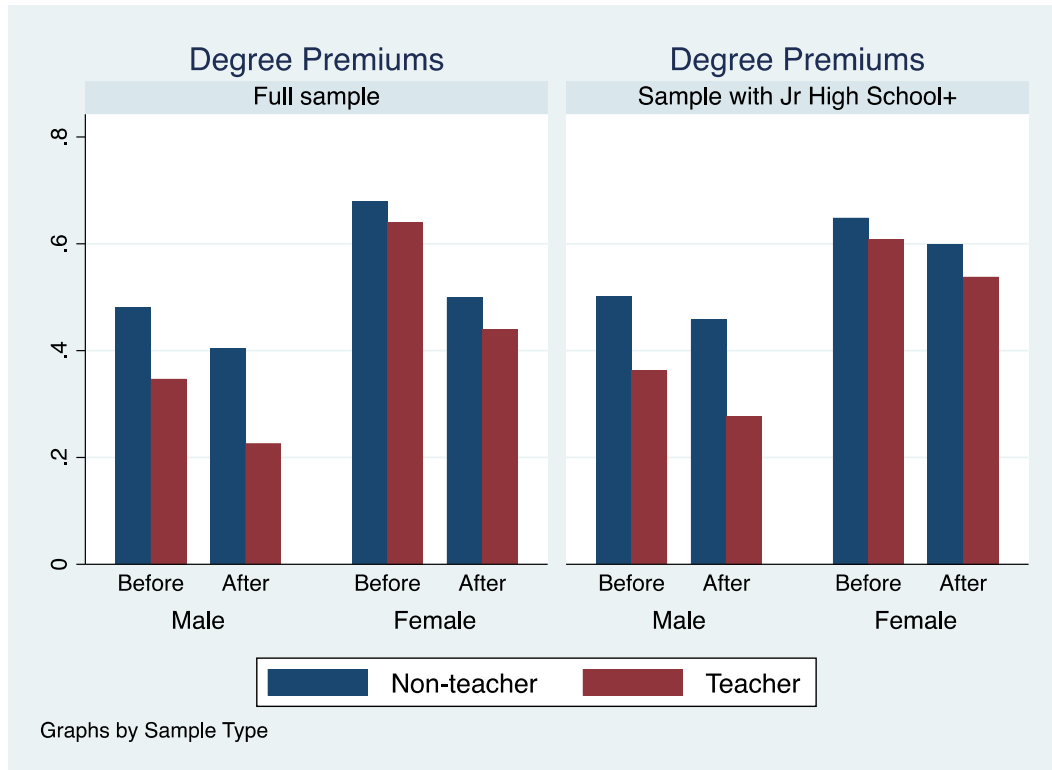
Notes: Standard errors in parentheses. \*:  $p < 0.05$ , \*\*:  $p < 0.01$ , \*\*\*:  $p < 0.001$ . The low and high salary areas are defined as prefecture-level cities with below and above median average salaries in each province in 2005, according to the official statistics (NBS 2006). The instruments are based on the HE expansion rates between 1992 and 1996.

**Table 4: Earning effects of HE expansion**

Dependent variable: Log monthly income	Full Sample		Sample with At Least Junior High School Qualification	
	Male (1)	Female (2)	Male (3)	Female (4)
HE qualification	0.4806*** (0.0088)	0.6795*** (0.0100)	0.5010*** (0.0094)	0.6486*** (0.0110)
Post-expansion	-0.2878*** (0.0048)	-0.3263*** (0.0048)	-0.2617*** (0.0062)	-0.3441*** (0.0072)
Teacher	0.4219*** (0.0421)	0.4340*** (0.0270)	0.3901*** (0.0423)	0.3884*** (0.0275)
HE qualification X Post- expansion	-0.0771*** (0.0122)	-0.1800*** (0.0133)	-0.0425*** (0.0138)	-0.0491*** (0.0158)
HE qualification X Teacher	-0.5553*** (0.0462)	-0.4730*** (0.0320)	-0.5285*** (0.0463)	-0.4287*** (0.0324)
Post-expansion X Teacher	-0.1440** (0.0629)	-0.1233*** (0.0384)	-0.1082* (0.0632)	-0.0852** (0.0389)
HE qualification X Post-expansion X Teacher	0.1000 (0.0687)	0.1026** (0.0451)	0.0655 (0.0688)	0.0642 (0.0456)
<i>N</i>	197,566	175,374	156,220	118,178

Notes: Standard errors in parentheses. \*:  $p < 0.05$ , \*\*:  $p < 0.01$ , \*\*\*:  $p < 0.001$ . Control variables are the same as in the 2SLS results, except for age. The earning regressions include experience and squares of experience as additional control variables.

**Figure 6: Effect of HE expansion on degree premiums in earnings, by gender, occupation and sample restrictions**



However, one disadvantage of this approach is that the estimates are complex and hard to interpret. Therefore, we visualize in Figure 6 the implied degree premiums in earnings in Table 4. These are effectively the returns to having an HE qualification for teachers and non-teachers, for pre- and post-HE expansion cohorts, holding all else constant, including gender and whether excluding those with below compulsory education. The left-panel suggests that graduates experience a significant pay penalty for being a teacher, regardless of gender and exposure to the HE expansion. Moreover, younger cohorts have lower degree premiums than their older counterparts.<sup>23</sup> Importantly, the gap in favour of non-teachers has not shrunk, and if anything, appear to have widened for males, for young cohorts exposed to the HE expansion. This pattern is confirmed in the right panel, which uses a more homogeneous subsample after excluding respondents with lower than junior high school qualifications. While the sizes of the earnings penalty for graduates who become teachers are now somewhat smaller than in the full sample, it is

<sup>23</sup> Using population-level administrative data from the UK, Britton et al. (2020) present compelling evidence of higher earnings growth for graduates than non-graduates in early-to-middle career in the UK.

still the case that post-expansion graduates are not attracted to the teaching profession due to relatively higher earnings.

Our analysis so far shows that the HE expansion has led to very substantial increases in the supply of new teachers with HE qualifications in general, more so for females and less developed areas. Moreover, there is no evidence that this is achieved through increased relative returns to HE qualification for teachers. One plausible explanation is that the increased supply of college-educated teachers could be driven by the increase in relative non-pecuniary benefits associated with being a teacher in an increasingly competitive graduate labour market. This could include more job security in public sector jobs, a guarantee of local urban *hukou* in the place of employment, better pension and housing benefits, longer holidays, lower working hours, and higher job satisfaction, as well as prioritised admissions of own children to schools where the parent is employed in the future.

While the mini-Census is less than ideal for the study of non-pecuniary benefits, we nevertheless provide some descriptive evidence in the Appendix. Panel B in Table A1 shows that among college graduates, teachers are more likely to hold *urban hukou*. Moreover, Table A2 shows migration patterns by graduate and teacher status. As we can only define migrant status by comparing the current place of residence to that 5 years ago, a “native” is more of a proxy for having the local *hukou*. While college graduates who are non-teachers are significantly more likely to migrate between provinces and between cities within the same province, they are almost 12 percentage points less likely to be “natives” than college-educated teachers. One plausible explanation is that graduates who become regular teachers have easier access to local *hukou*, which is highly valued, especially in municipalities and provincial capitals.

Figures A4A-A4E present college premiums similar to Figure 6, but in terms of log house size, house ownership, living in public housing (subsidised compared to private rental), having a (permanent or long-term) labour contract, and weekly working hours, respectively. These are derived from estimates in Appendix Table A3 which uses the subsample of respondents with at least a junior high school qualification and distinguishing between college diplomas and university degrees. Except for working hours, new college-educated teachers exposed to the expansion enjoy improvements in all non-pecuniary benefits relative to their pre-expansion counterparts, at least for those with college diplomas. For non-teacher graduates, the trend moves in the opposite direction.

We interpret this as suggestive evidence that the non-pecuniary benefits in teaching have in general improved relative to non-teaching careers, for post-expansion graduates.

To better understand the heterogeneous effects of the HE expansion, we next examine the extent to which the college earnings premium varies by gender and area type, as well as ability. Empirically, we estimate earnings equations conditional on the occupational choice into teaching, and examine how the college wage premiums change for post-expansion cohorts across gender and area type, relative to pre-expansion cohorts.

Moreover, Quantile Regressions (QR) are also explored to compare the impact of the HE expansion on the college premiums along the conditional quantiles of the earnings distribution, which gives an indication of the role of the unobserved “ability” or “quality”, often used as a shorthand by labour economists for unobserved cognitive and non-cognitive skills that are unaccounted for in the OLS earnings equations (see e.g. Walker & Zhu, 2008). Compared to the OLS estimates which focus on the marginal effects at the conditional mean of the response variable, QR estimates allow characterization of the relationship between the variable of interest and the response across the **entire** conditional quantile distribution and are more robust against outliers (Angrist & Pischke, 2009).

**Table 5: Heterogeneous effect of HE expansion on the earnings, by area types**

Dependent variable: Log monthly income	Teacher		Non-teacher	
	Male (1)	Female (2)	Male (3)	Female (4)
<b>Low salary areas</b>				
HE qualification	0.1946*** (0.0408)	0.3634*** (0.0345)	0.4225*** (0.0143)	0.6616*** (0.0166)
Post-expansion	-0.0448 (0.0515)	-0.1700*** (0.0398)	-0.2498*** (0.0070)	-0.2961*** (0.0067)
HE qualification X Post-expansion	0.0083 (0.0512)	0.0550 (0.0430)	-0.1082*** (0.0200)	-0.1825*** (0.0223)
N	1,698	2,565	88,069	80,382
<b>High salary areas</b>				
HE qualification	0.1534*** (0.0529)	0.3581*** (0.0386)	0.4481*** (0.0115)	0.5891*** (0.0134)
Post-expansion	-0.1442** (0.0635)	-0.2457*** (0.0464)	-0.2491*** (0.0072)	-0.2993*** (0.0078)
HE qualification X Post-expansion	0.0804 (0.0667)	0.1217** (0.0481)	-0.0401** (0.0159)	-0.1766*** (0.0178)
N	1,523	2,760	84,035	70,201

Note: Standard errors in parentheses. \*: p<0.05, \*\*: p<0.01, \*\*\*: p<0.001. Same controls as in Table 4.

Conditional on being a teacher, Table 5 suggests that young college-educated teachers exposed to the HE expansion enjoy an increased earnings premium relative to pre-expansion college-educated teachers, although this premium is only statistically significant for females in high salary areas. On the other hand, in non-teaching occupations, younger graduates exposed to the HE expansion suffer from a statistically significant earnings penalty relative to older graduates, regardless of gender and area type. The latter is consistent with earlier studies such as Li et al. (2017b) who present compelling evidence that the increased supply of HE graduates, albeit from the subsequent *Great HE Expansion* starting in 1999, has raised college premiums for older graduates at the expense of younger graduates. It is reasonable to expect the sudden increase in the supply of new graduates due to the 1992/93 HE expansion would also have imposed similar downward pressures on earnings for young cohorts. Therefore, the fact that different patterns are found for teachers versus non-teachers indicate that teachers' recruitment have become more market oriented and sufficiently competitive in the post-expansion era in satisfying localized demand of college-educated teachers.

Finally, we present in Table 6 evidence on heterogeneous effects of the HE expansion on earnings regarding unobserved abilities using quantile regressions, by gender and occupational selection into teaching. As expected, there is a negative ability gradient in the college premium for both genders, which is much steeper for women. Similarly, the returns to being a teacher (regardless of qualification) are decreasing in ability, with the gradient steeper for men. While the teacher penalty for graduates is large and significant for both genders, it is more pronounced for low-ability male graduates but virtually flat across the conditional earnings distribution for females. Moreover, there is evidence that the HE expansion has induced earnings penalty for teachers at the 70<sup>th</sup> percentile for men and between the 50<sup>th</sup> and the 70<sup>th</sup> percentiles for women.

We then visualize in Figure 6 the degree premiums along the conditional earnings quantiles by gender, for teacher and non-teacher graduates and for pre- and post-expansion cohorts. For non-teacher graduates, the ability gradient is monotonically decreasing for women, but decreasing only up to the median before flattening out for the upper half of the ability distribution for men. Moreover, there is virtually no change in the ability gradient over time for non-teachers.

On the other hand, the negative ability gradients for teachers are steeper than their non-teacher counterparts for both genders. This pattern does not appear to be affected by the HE expansion.

Regardless of the exposure to the expansion, the ability gradient curves for teachers cut across those of non-teachers around the 10<sup>th</sup> percentiles for men, and at around the 30<sup>th</sup> percentiles for women. This suggests that after the HE expansion, teaching continues to attract only male graduates from the bottom of the ability distribution, and female graduates up to the low-middle ability distribution.

**Table 6: Quantile earning effects of higher education expansion**

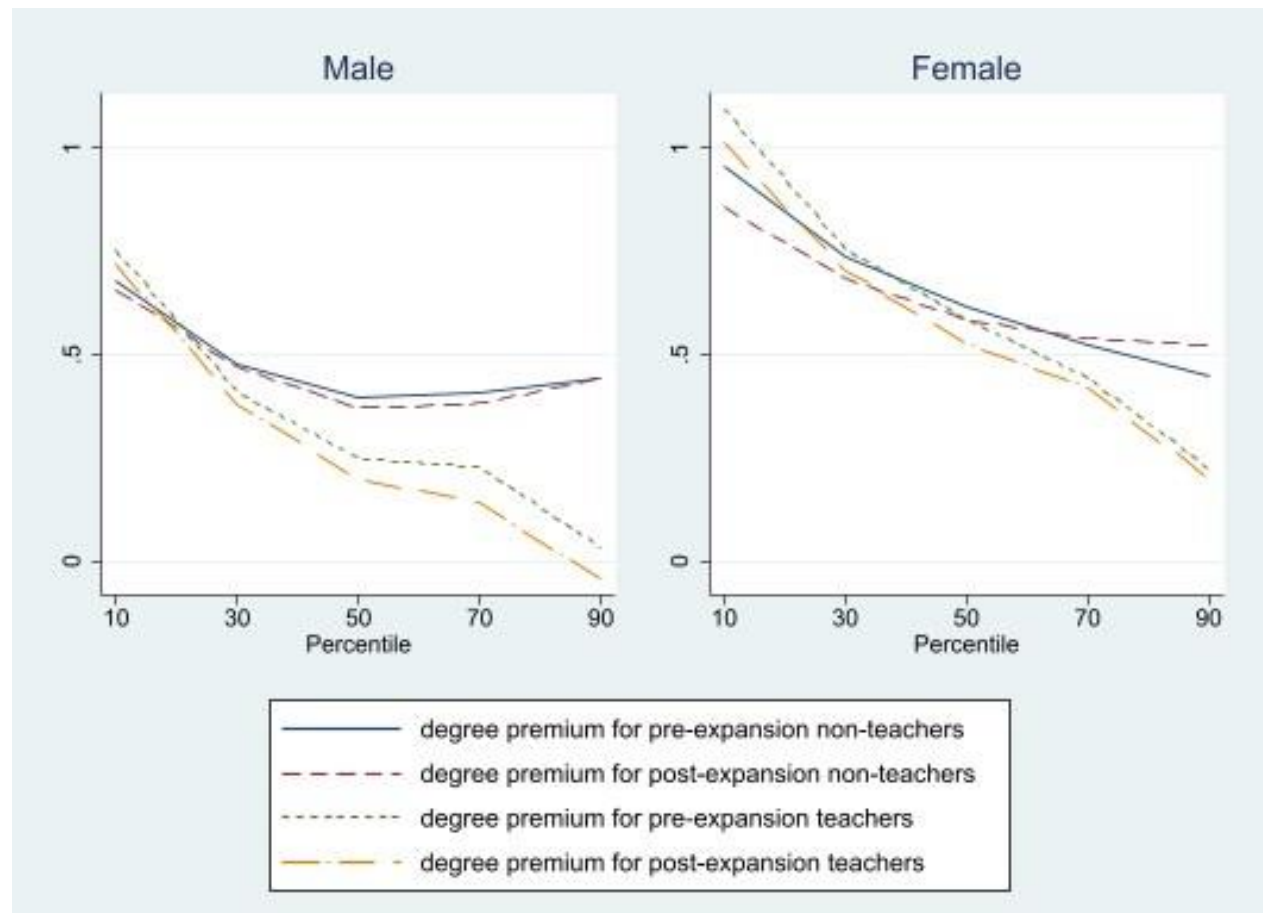
	<b>Q10</b> <b>(1)</b>	<b>Q30</b> <b>(2)</b>	<b>Q50</b> <b>(3)</b>	<b>Q70</b> <b>(4)</b>	<b>Q90</b> <b>(5)</b>
<b>Males (N=156,220):</b>					
HE qualification	0.6808*** (0.0161)	0.4741*** (0.0134)	0.3971*** (0.0123)	0.4084*** (0.0114)	0.4435*** (0.0160)
Post-expansion	-0.2760*** (0.0106)	-0.2884*** (0.0088)	-0.2711*** (0.0081)	-0.2132*** (0.0075)	-0.2368*** (0.0105)
Teacher	0.6911*** (0.0719)	0.4741*** (0.0599)	0.2763*** (0.0553)	0.2518*** (0.0510)	0.1237* (0.0716)
HE qualification X Post-expansion	-0.0247 (0.0234)	-0.0047 (0.0195)	-0.0269 (0.0180)	-0.0269 (0.0166)	-0.0012 (0.0233)
HE qualification X Teacher	-0.6196*** (0.0788)	-0.5387*** (0.0655)	-0.4247*** (0.0605)	-0.4335*** (0.0558)	-0.5349*** (0.0784)
Post-expansion X Teacher	-0.1519 (0.1074)	-0.1284 (0.0894)	-0.0906 (0.0826)	-0.1522** (0.0762)	-0.0503 (0.1070)
HE qualification X Post-expansion X Teacher	0.1440 (0.1170)	0.1044 (0.0974)	0.0658 (0.0899)	0.0928 (0.0830)	-0.0269 (0.1165)
<b>Females (N=118,178):</b>					
HE qualification	0.9568*** (0.0202)	0.7372*** (0.0139)	0.6140*** (0.0137)	0.5207*** (0.0138)	0.4505*** (0.0170)
Post-expansion	-0.2413*** (0.0131)	-0.3183*** (0.0090)	-0.3311*** (0.0089)	-0.3429*** (0.0090)	-0.3222*** (0.0110)
Teacher	0.5299*** (0.0503)	0.4280*** (0.0346)	0.4282*** (0.0342)	0.3430*** (0.0344)	0.1771*** (0.0422)
HE qualification X Post-expansion	-0.0968*** (0.0288)	-0.0547*** (0.0198)	-0.0289 (0.0196)	0.0183 (0.0197)	0.0717*** (0.0242)
HE qualification X Teacher	-0.3914*** (0.0592)	-0.4090*** (0.0407)	-0.4570*** (0.0403)	-0.4198*** (0.0405)	-0.4035*** (0.0497)
Post-expansion X Teacher	-0.0151 (0.0710)	-0.0528 (0.0489)	-0.1161** (0.0483)	-0.1151** (0.0486)	-0.0829 (0.0597)
HE qualification X Post-expansion X Teacher	0.0326 (0.0832)	0.0552 (0.0572)	0.0866 (0.0566)	0.0720 (0.0570)	-0.0102 (0.0699)

Note: Standard errors in parentheses. \*: p<0.05, \*\*: p<0.01, \*\*\*: p<0.001. Same controls as in Table 4.

These findings are consistent with low returns to ability in teaching, as opposed to other graduate occupations dominated by a more competitive and rewarding private sector, especially for men. Our findings indicate that the impressive increase in college-educated teachers over a relatively short period of time is **not** achieved through recruiting better quality male teachers, which underpins the gendered pattern we have shown. However, given the relatively poor average qualifications teachers

in the first place, one might still expect the overall quality of teachers to increase over this critical period in the transformation of education in China.

**Figure 6: Occupation-specific Degree Premiums by Conditional Earning Quantiles, by Gender and Exposure to HE expansion**



## 7. Conclusions

This paper examines the teacher labour market in China using the 2005 mini-Census, in the context of the transformation of the world's largest education system. We document a significant increase not only in the quantity, but also the quality of teachers during 1990-2005. Instrumental Variables results based on the natural experiment of a substantial expansion of higher education (HE) in 1992/93 indicate that the expansion has a large positive causal effect on supply of secondary school teachers. Consistent with differential opportunity costs, the supply effect is more pronounced for women and those living in less developed regions.



While a conventional earnings equation analysis shows no evidence of an increase in the college premium for teachers resulting from the HE expansion, there appears to be improvements in the relative non-pecuniary benefits associated with being a teacher for post-expansion graduates. Additional heterogeneous effect analysis indicates that different patterns in terms of college premiums have emerged between teaching and non-teaching occupations, across such dimensions as gender, region type and the conditional earning distribution. We interpret this as suggestive evidence that teacher recruitment has become more market-oriented and sufficiently competitive, in attracting low to lower-middle ability graduates into teaching, in an increasingly competitive graduate labour market.

Our findings indicate that the 1992/93 HE expansion, which has largely been overlooked by researchers, has been instrumental in the phenomenal growth in the supply of college-educated schoolteachers. This in turn underpins China's achievement of near universal lower-secondary education by 2005, as well as a massive expansion of upper-secondary education since the mid-1990s which prepared the ground for the subsequent *Great HE Expansion* starting in 1999. Without the earlier expansion which markedly improved the quantity and quality of secondary schoolteachers, the *Great HE Expansion* could not have been sustained due to the severe bottleneck in the supply of graduate-level secondary schoolteachers.

While our results suggest that an emerging decentralized and market-oriented teacher labour market has served its purpose of satisfying the surging demand for college-educated secondary schoolteachers in China by and large, a serious concern of this approach is the inevitable widening of inequality across rich and poor regions, aggravated by the *hukou* system. With the achievement of universal nine-year compulsory and the rapid massification of HE, the acute challenge in China's ongoing educational transformation is to achieve twelve-year compulsory education without compromise in quality or equity. The current policy that only allows about half the junior high school graduates to proceed to the academic track of upper-secondary education is neither efficient nor equitable. However, to prepare the ground for a future expansion of senior high schools, our study implies that it is important to increase the supply of would-be teachers with both good general academic qualifications and adequate specific knowledge in the right subject fields, ideally a few years before the expansion starts. Another lesson one can draw from this research is that local education authorities should pay attention to the role of both pay and non-pecuniary benefits, relative

to other graduate occupations in the localised labour market, in recruiting and retaining talented teachers.

The main limitation of this analysis is the cross-sectional nature and the limited set of variables in the mini-Census. This implies that we cannot study the earnings and employment dynamics of the teacher labour market, including attrition and mobility. To push forward the research frontiers, more effort is needed in the future from researchers and the government to collect tailored surveys and to make administrative data more accessible.

Nevertheless, our analysis sheds light on the functioning of the world's largest teacher labour market, the successful transformation of which underpins China's phenomenal economic performance over the last 4 decades. This could in turn help inform evidence-based policymaking on improving the supply of high-quality teachers in developing countries, which is the single most important education policy instrument influencing student achievement (OECD, 2005).

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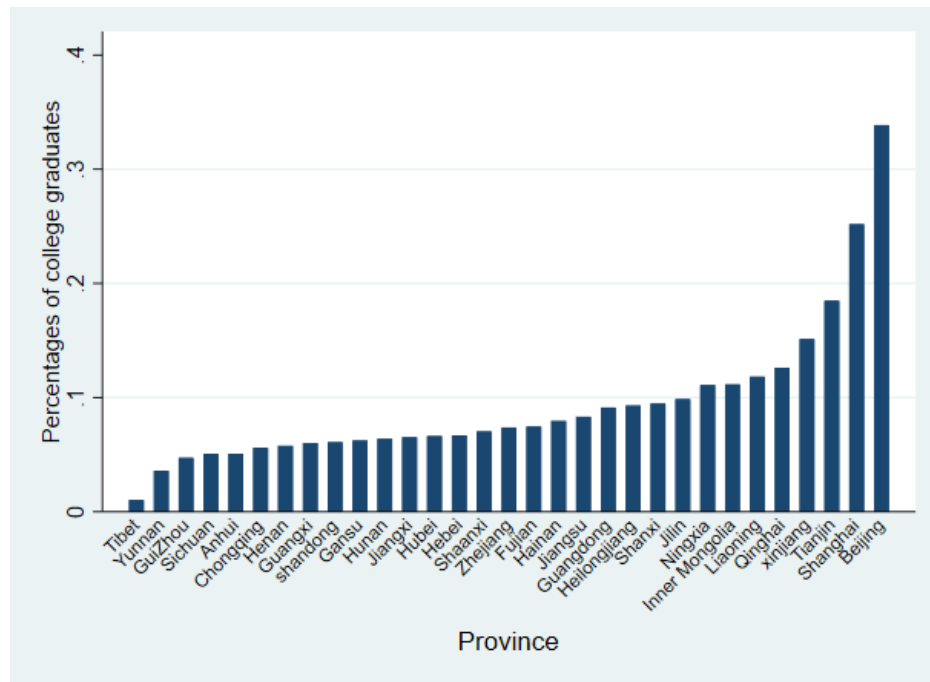
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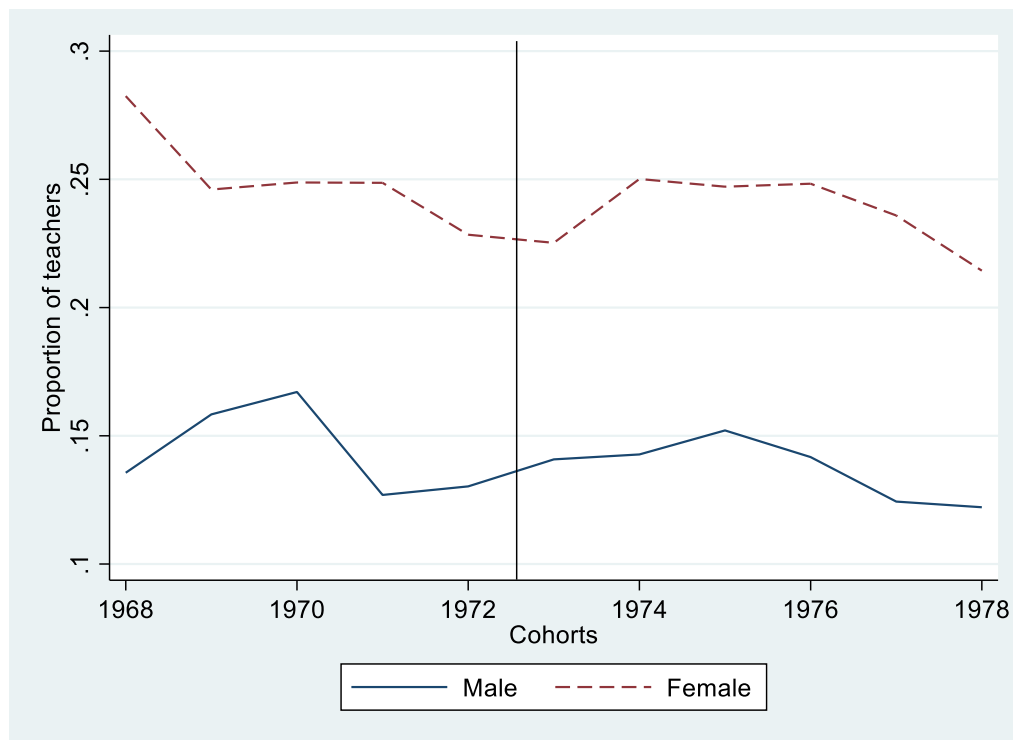
## Appendix

**Figure A1: Share of HE graduates by provinces of *hukou* registration**



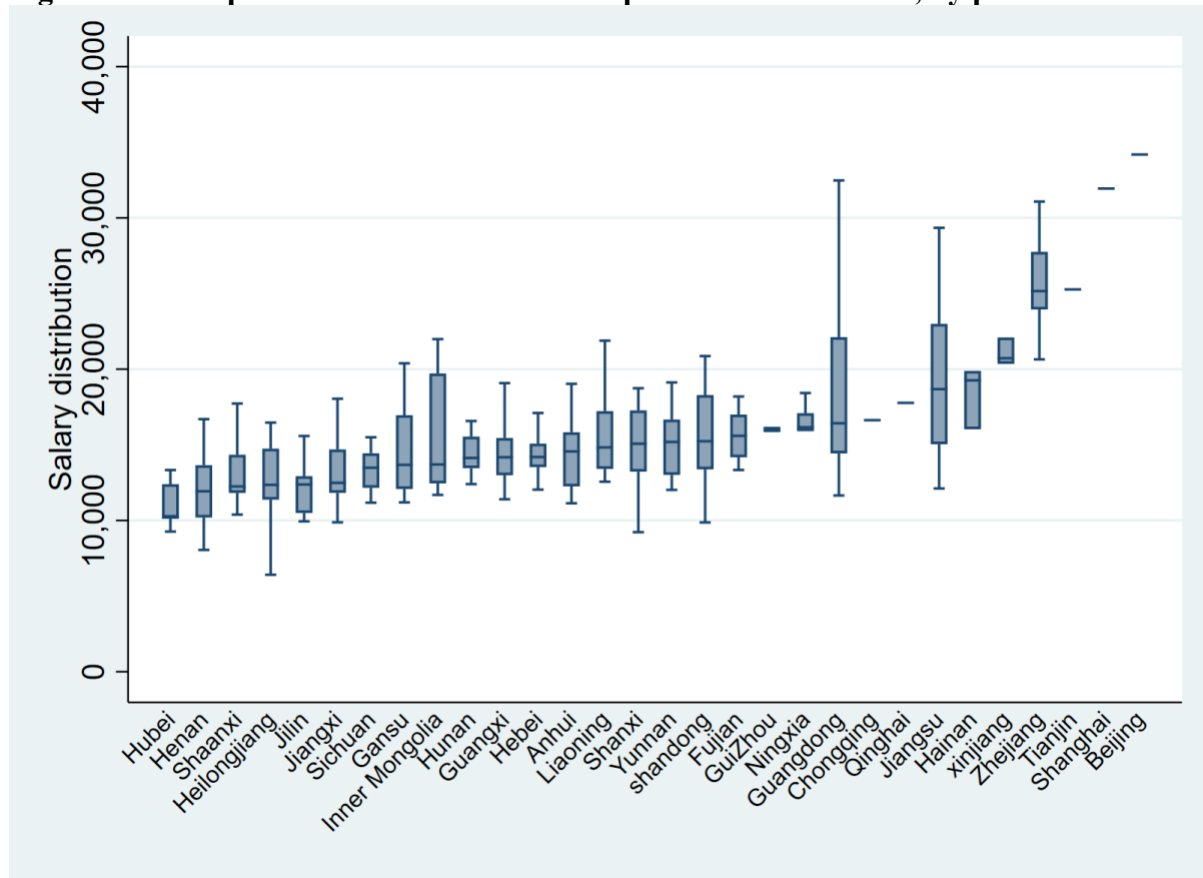
Note: Respondents aged 25-60 in the full sample.

**Figure A2: Share of teachers among HE graduates, by birth cohort**



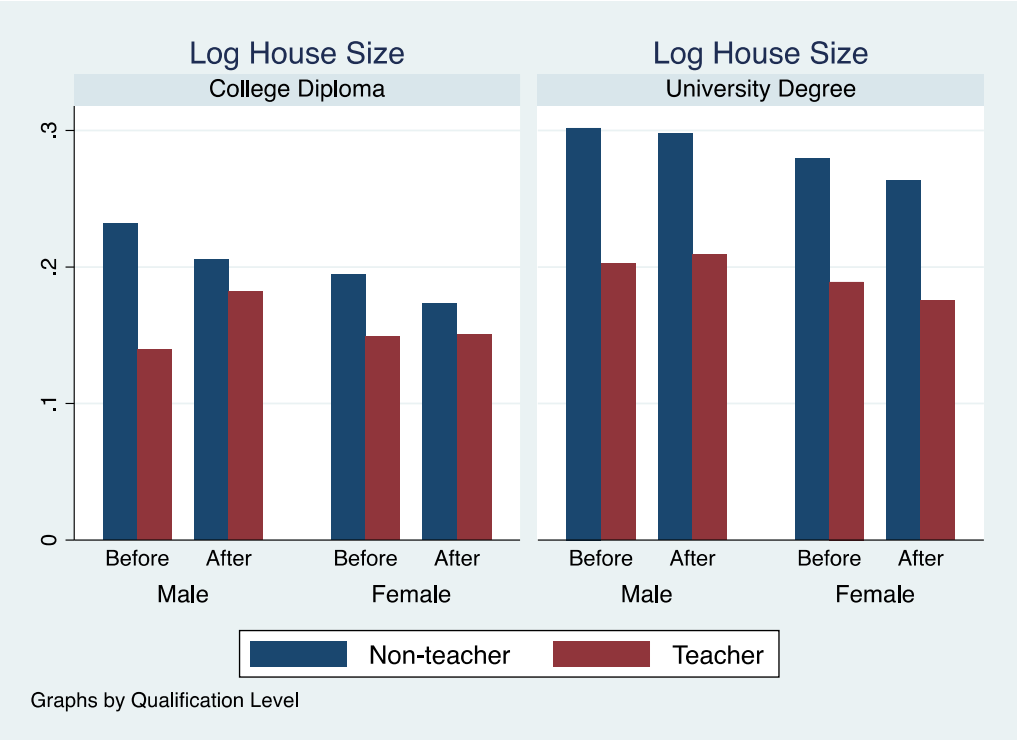
Note: Analytic sample. Vertical line corresponds to the beginning of the 1992/93 HE expansion.

**Figure A3: Box plots of mean salaries across prefecture-level cities, by province.**

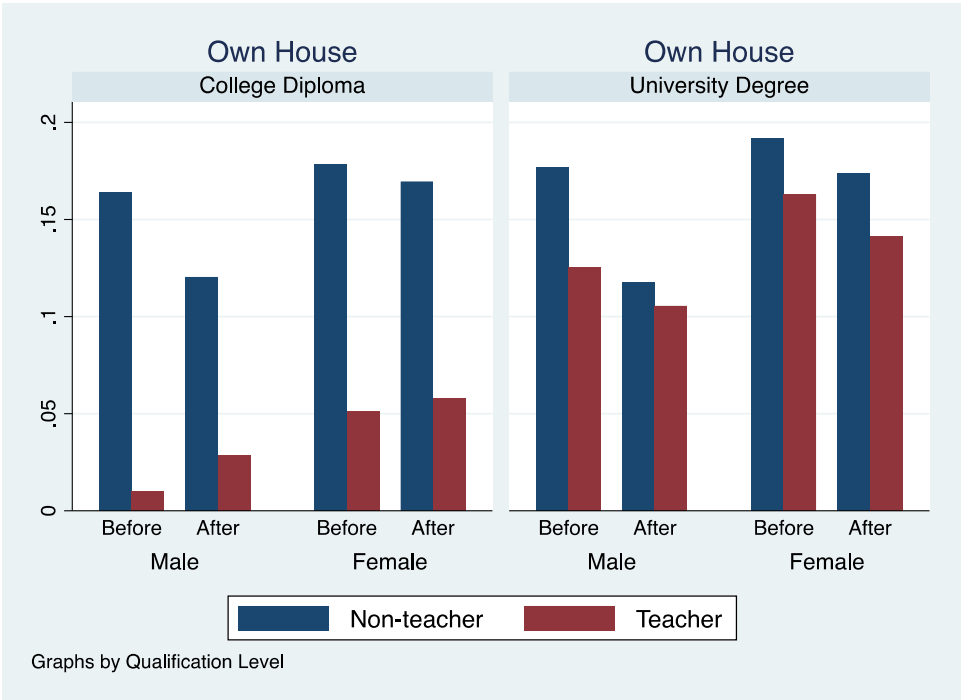


Note: Each box plot describes a salary distribution of prefecture-level cities within a province. The box plot shows the **median**, the 25<sup>th</sup>/75<sup>th</sup> percentile, and upper/lower adjacent salaries (i.e. 1.5 times the inter-quartile range) across different provinces. The low and high salary areas are defined as prefecture-level cities with below and above median average salaries in a province in 2005, according to the official statistics (NBS 2006). The provinces without the box are municipals and are defined as high salary areas due to their economic status.

**Figure A4A: Log house size for non-teachers and teachers, by gender, qualification and exposure to HE expansion**

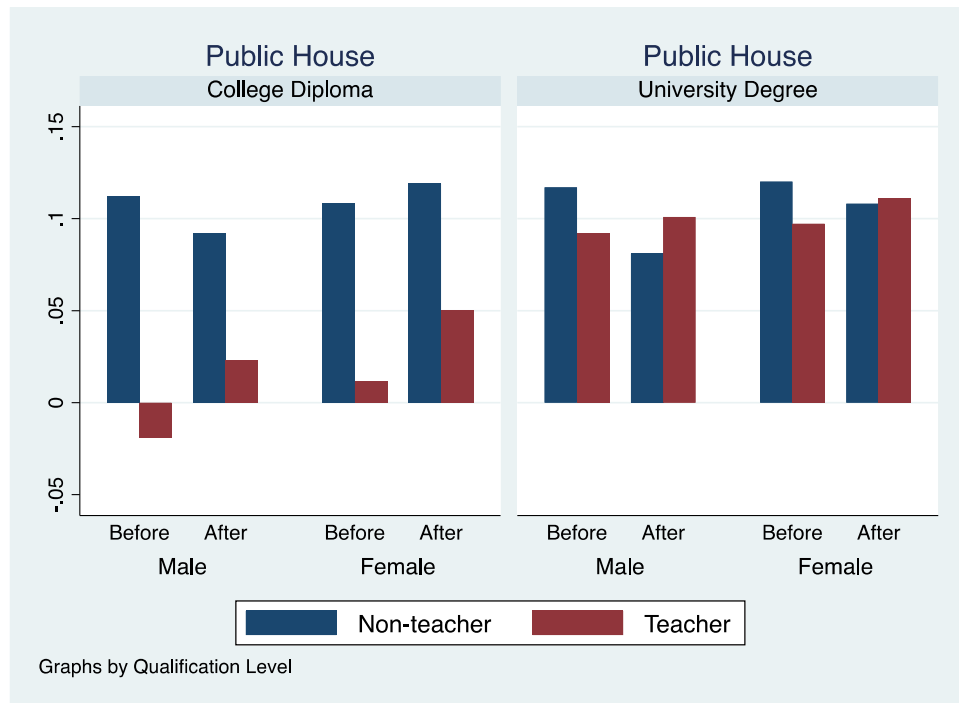


**Figure A4B: House ownership for non-teachers and teachers, by gender, qualification and exposure to HE expansion**

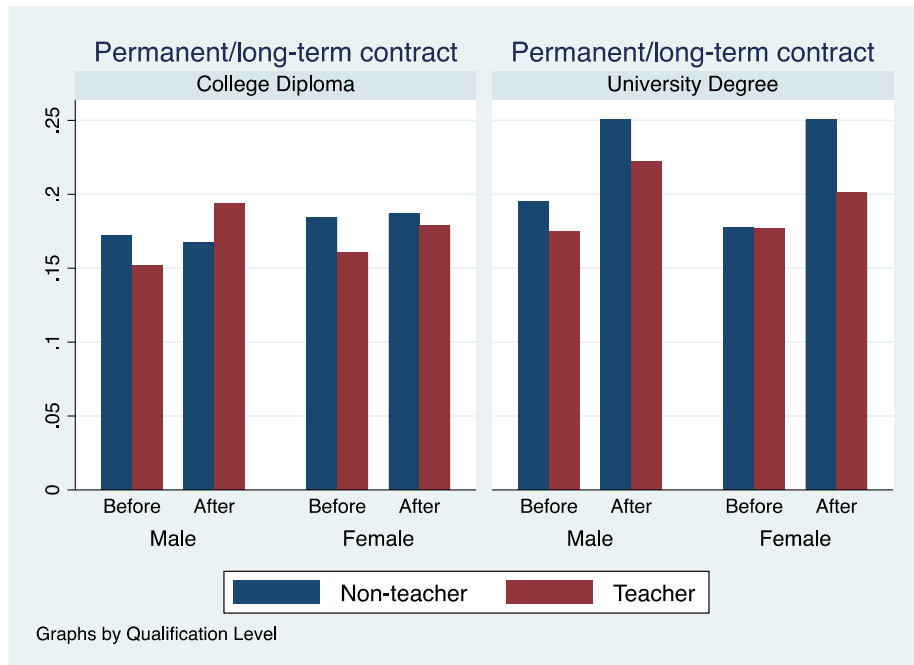




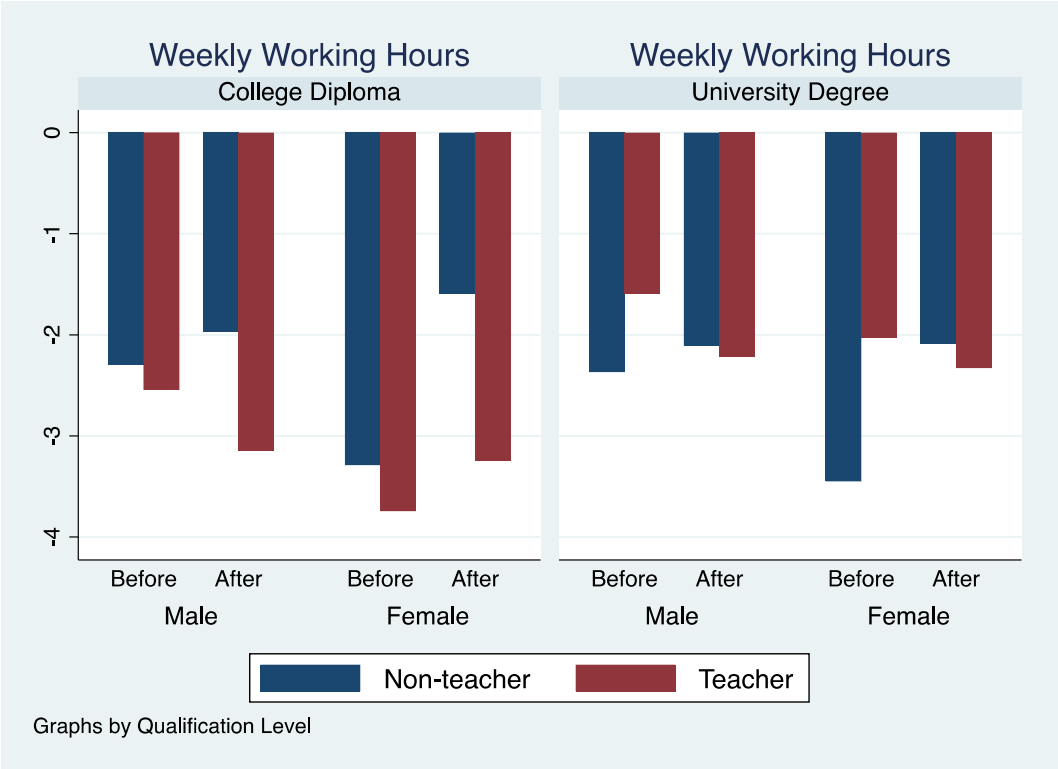
**Figure A4C: Public housing access for non-teachers and teachers, by gender, qualification and exposure to HE expansion**



**Figure A4D: Permanent/Long-term Contract, by gender, qualification and exposure to HE expansion**



**Figure A4E: Weekly Working Hours, by gender, qualification and exposure to HE expansion**



**Table A1: Summary statistics by gender****Panel A, all sample**

VARIABLES	Teacher		Non-teacher	
	Mean	SD	mean	SD
Male	0.38	0.49	0.53	0.50
Urban <i>hukou</i>	0.92	0.28	0.26	0.44
Age	31.76	2.89	32.13	2.84
No education	0.00	0.02	0.03	0.18
Primary	0.00	0.06	0.24	0.43
Junior high	0.05	0.22	0.50	0.50
Senior high	0.14	0.35	0.14	0.34
College	0.46	0.50	0.06	0.24
University	0.35	0.48	0.03	0.17
Year of experience	10.18	3.48	16.17	4.40
Han ethnicity	0.90	0.31	0.89	0.31
Married	0.92	0.27	0.91	0.29

**Panel B, individuals with higher education**

VARIABLES	Teacher		Non-teacher	
	Mean	SD	Mean	SD
Male	0.41	0.49	0.57	0.49
Urban <i>hukou</i>	0.97	0.16	0.95	0.22
Age	31.76	2.88	31.68	2.87
College	0.57	0.49	0.67	0.47
University	0.43	0.49	0.33	0.47
Year of experience	9.33	2.92	9.35	2.91
Han ethnicity	0.89	0.31	0.93	0.25
Married	0.92	0.27	0.85	0.36

**Table A2: University graduates and migration**

	University graduates		Non-university graduates	
	Non-teacher	Teacher	Non-teacher	Teacher
Natives	70.91%	82.73%	87.68%	88.92%
Migration within city	12.59%	11.44%	3.31%	7.71%
Migration within province	9.61%	4.60%	3.16%	2.47%
Migration between provinces	6.89%	1.23%	5.85%	0.90%
	100%	100%	100%	100%

**Table A3: Non-pecuniary benefits by gender**

	Dependent variable: House size		Dependent variable: Owning a house	
	Male (1)	Female (2)	Male (3)	Female (4)
College	0.2321*** (0.0100)	0.1947*** (0.0111)	0.1642*** (0.0046)	0.1785*** (0.0058)
University	0.3019*** (0.0130)	0.2793*** (0.0156)	0.1770*** (0.0059)	0.1920*** (0.0081)
Post-expansion	-0.0503*** (0.0059)	-0.0658*** (0.0065)	-0.1116*** (0.0027)	-0.1439*** (0.0034)
Teacher	0.2269*** (0.0398)	0.1167*** (0.0250)	0.0296 (0.0181)	0.0539*** (0.0130)
College X Post-expansion	-0.0263* (0.0145)	-0.0215 (0.0157)	-0.0438*** (0.0066)	-0.0090 (0.0082)
University X Post expansion	-0.0038 (0.0190)	-0.0158 (0.0222)	-0.0592*** (0.0087)	-0.0182 (0.0115)
College X Teacher	-0.3195*** (0.0463)	-0.1621*** (0.0319)	-0.1840*** (0.0211)	-0.1812*** (0.0166)
University X Teacher	-0.3264*** (0.0481)	-0.2069*** (0.0355)	-0.0813*** (0.0219)	-0.0830*** (0.0185)
Post-expansion X Teacher	-0.0550 (0.0595)	0.0279 (0.0353)	0.0229 (0.0271)	0.0122 (0.0184)
College X Post-expansion X Teacher	0.1241* (0.0685)	-0.0053 (0.0449)	0.0394 (0.0312)	0.0036 (0.0234)
University X Post-expansion X Teacher	0.0652 (0.0713)	-0.0257 (0.0496)	0.0165 (0.0325)	-0.0155 (0.0259)
<i>N</i>	155,615	117,861	155,615	117,861

	Dependent variable: Public housing		Dependent variable: Having a contract	
	Male (5)	Female (6)	Male (7)	Female (8)
College	0.1122*** (0.0048)	0.1085*** (0.0059)	0.1723*** (0.0051)	0.1844*** (0.0063)
University	0.1170*** (0.0062)	0.1201*** (0.0083)	0.1953*** (0.0067)	0.1778*** (0.0088)
Post-expansion	-0.1097*** (0.0028)	-0.1326*** (0.0035)	-0.1020*** (0.0030)	-0.1208*** (0.0037)
Teacher	0.0086 (0.0190)	0.0819*** (0.0133)	0.1360*** (0.0203)	0.1746*** (0.0141)
College X Post-expansion	-0.0202*** (0.0069)	0.0106 (0.0084)	-0.0051 (0.0074)	0.0025 (0.0089)
University X Post expansion	-0.0360*** (0.0091)	-0.0120 (0.0118)	0.0554*** (0.0097)	0.0727*** (0.0125)
College X Teacher	-0.1398*** (0.0221)	-0.1786*** (0.0170)	-0.1565*** (0.0237)	-0.1986*** (0.0181)
University X Teacher	-0.0335 (0.0229)	-0.1047*** (0.0189)	-0.1565*** (0.0245)	-0.1754*** (0.0201)
Post-expansion X Teacher	0.0120 (0.0283)	-0.0638*** (0.0188)	-0.0401 (0.0304)	-0.0822*** (0.0200)
College X Post-expansion X Teacher	0.0502 (0.0327)	0.0915*** (0.0239)	0.0872** (0.0350)	0.0981*** (0.0254)
University X Post-expansion X Teacher	0.0328 (0.0340)	0.0897*** (0.0264)	0.0321 (0.0364)	0.0335 (0.0281)
<i>N</i>	155,615	117,861	155,615	117,861

	<b>Dependent variable: Working hours</b>	
	<b>Male</b> (9)	<b>Female</b> (10)
College	-2.2967*** (0.3648)	-3.2895*** (0.3930)
University	-2.3683*** (0.4740)	-3.4501*** (0.5483)
Post-expansion	0.4188* (0.2161)	-0.0076 (0.2343)
Teacher	-2.7110* (1.5279)	-3.3807** (0.8883)
College X Post-expansion	0.3280 (0.5172)	1.6981*** (0.5486)
University X Post expansion	0.2623 (0.6697)	1.3592* (0.7601)
College X Teacher	2.4621 (1.7587)	2.9266** (1.1380)
University X Teacher	3.4889* (1.8191)	4.8051*** (1.2619)
Post-expansion X Teacher	-3.3979 (2.1894)	-0.1940 (1.2474)
College X Post-expansion X Teacher	2.4720 (2.5045)	-1.0051 (1.5832)
University X Post-expansion X Teacher	2.5098 (2.5975)	-1.4699 (1.7407)
<i>N</i>	118,049	89,089

Note: Standard errors in parentheses. \*:  $p < 0.05$ , \*\*:  $p < 0.01$ , \*\*\*:  $p < 0.001$ . Same controls as in Table 4.