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BIRTH SEASON, WATER AND EDUCATION RETURN IN CHINA

Lili Kang

Centre of Research on the Economy and the Workplace (CREW)

Birmingham Business School

ABSTRACT

This essay investigate the returns to education in China using pooled CHNS (China Health and Nutrition Survey) dataset before 2000 (including 1989, 1991, 1993 and 1997) and after 2000 (including 2000, 2004 and 2006). Based on the standard Mincerian human capital earning function, we adopt the OLS and IV models to see the difference of controlling endogeneity of schooling or not. Education is measured in two ways: years of schooling (input) and highest educational qualification (output, 5 categories of educational levels). We find that OLS estimate of the returns to schooling and education levels in the 2000s is higher than before, and higher education, higher return. In addition, if we do not control for endogeneity bias of schooling, the OLS estimates of the returns to schooling will be underestimated, especially before 2000.

JEL codes: I21

Keywords: Birth season; Returns to schooling; China Health and Nutrition Survey

Preliminary, not for quotation

Introduction

For at least a decade following the economic reforms initiated in the early 1980s, scholars have found unusually low returns to education in China. Returns to education provide the information about the incentives for human capital accumulation, the efficiency of resource allocation, and the distributional consequences of differences in human capital. With the CHNS (China Health and Nutrition Survey) data, our paper adopt the ordinary least square (OLS) and instrumental variable (IV) methodology to presents a significant change in education returns from 1989 to 2006 in China.

In this paper, we answer two important questions: Do the returns to education in China differ before and after 2000? What are the valid instruments for years of schooling? Do the OLS estimates, i.e., estimates which ignore the endogeneity bias, differ significantly from the estimates that consider this bias?

The rest of this paper is organised as follows. In the next section, we briefly discuss the evolution of China's labour market institutions and ownership structure which affect wage determination. In Section III, we provide a literature review on the returns to education in China. In section IV, we present the OLS and IV empirical specifications. Data descriptive and estimates of the returns to schooling are presented in Section V. Section VI concludes.

Evolution of labour market

From the foundation of PRC to the late 1970s, state-owned sectors dominate in the urban China, and the Bureau of Labour and Personnel centrally determined and controlled the wages of all workers through a grade system to reduce labour costs for rapid industrialization. Low wages were made possible by state-subsidized food prices and state provision of non-wage benefits to workers and their families, such as housing, child care, medical insurance, and pensions. At the same time, the government effectively eliminated most of the direct private costs of education by waiving all tuitions and fees for college students and by providing living stipends to students from poor families.

This heavy planning led to poor effect incentive which depressed productivity and innovation. In the early 1980s, Deng Xiaoping reformed the economy beginning with the rural "Household Responsibility System". However, the welfare guarantees to employees hindered

the urban reforms until the middle and late 1990s. In October 1984, the Communist Party passed the "Resolution on Economic Institutional Reform," which changed the fixed wage quota system to a floating total wage system, by allowing profitable firms to pay higher salaries and bonus to more productivity workers (Dai, 1994).

In 1986, the State Council issued "Temporary Regulations on the Use of Labour Contracts in State- Run Enterprises," formally introduced labour contracts to end the system of permanent employment (Meng, 2000). Zhang et.al. (2005) show that by 1997, one hundred million employees had signed labour contracts with their employers. Most workers who quit state-owned enterprises voluntarily moved to the non-state sector. Since the early 1990s, non-state enterprises, including foreign, private, and mixed ownership enterprises, have emerged as prominent players in the labour market. By competing aggressively with the public sector, these firms provided an impetus for state-sector restructuring.

In addition, the institutional barriers to off-farm labour participation have been attenuated. The SSBa (1990–2000) have documented a series of policies that loosened restrictions on labour mobility out of agriculture. During 1986 to 1995, the percentage of rural labour force employed in township and village enterprises (TVEs) increased from 12.8% to 22.2% (SSBb, 1996).Maurer-Fazio (1999) show the rising significance of education as a determinant of off-farm earnings, a result that implies individuals are being rewarded more for their human capital, which is a sign of well-functioning markets.

Literature review

Many researchers used OLS methodology to examine the rates of returns to education in China. However, plenty of literatures (such as, Heckman and Li, 2004; Li and Luo, 2004) pointed out the endogenous bias of education and used the IV methodology to cope with this problem. Normally, the IV estimators are higher than the OLS estimators of the conventional Mincerian model.

Chen and Hamori (2009) examines economic returns to schooling in urban China using OLS and IV methodologies for women and men with the CHNS 2004 and 2006 pooled data, and their instruments for schooling is spouse education. Heckman and Li (2004) use the 2000 data from the China Urban Household Income and Expenditure Survey (CUHIES) to identify

the returns to higher education for young people in the urban areas of the six provinces. The instruments employed are parental education and year of birth, and the IV estimator of average return to four-year college attendance was 43% (on average, 11% annually).

Li and Luo (2004) use the CHIP 1995 data and apply various IV estimations to estimate returns to schooling for young workers in urban China. Their result is robust using either parental education or sibling variables as instruments. Yang (2005) uses CHIP 1988 and 1995 data to study the changes over time in returns to education for a large number of Chinese cities. On average, he reports that the estimated rates of return at the city level increased from 3.1% in 1988 to 5.1% in 1995.

Fleisher, Li, Li and Wang (2005) adopt three methods, i.e., OLS, IV, and semi-parametric (SPIV) to estimate how selection and sorting influenced the evolution of the private returns to schooling for college graduates with CHIP 1988, 1995 and 2002 dataset. All three methods show a substantial increase in returns to schooling between 1995 and 2002. The IV and SPIV estimates of the returns to college education also turn out to be sensitive to the use of a proxy for ability. The IV instruments are parental schooling and parental income.

Birth season and educational attainment

There are many literatures in the effects of season of birth on sports find the “relative age effect”. The idea is that elder children have a developmental advantage over the younger children in the same age group. By doing better, the older children in a given age group achieve more success and receive greater rewards for their endeavors. Younger students’ frustration results in lower expectations lowering the odds of completing their sporting career. Examples are discussed in Dudink (1994) or Thompson, Barnsley and Steberlsky (1991).

This phenomenon can be applied to schooling performance and career as well. Educational psychologists acknowledge that cutoff dates contribute to a relative age effect. The more matured get better marks, have fewer difficulties in school, and often achieve a higher level of education (Sharp, 1995). Season of birth is unlikely to be correlated with personal attributes other than age at school entry. Angrist and Krueger (1991) pioneered the use of this exogenous variable as potential instrument for years of schooling.

In the USA, the cut-off date for the compulsory schooling is 1st Jan and the compulsory schooling laws generally require student to remain in school until their 16th or 17th birthday. They argue that people born after the cut-off date have less years of schooling, since they start at an older age and can therefore drop out after less years of schooling than people who are born before the cut-off date.

Plug (2001) argued that the AK's effect can achieve if and only if children are allowed to quit school as soon as they reach this age. The AK's effect does not exist in the Netherland, since children who reach their school leaving age have to finish the class they began with, same as the regulation in China.

The Chinese compulsory schooling law was implemented on 1st July 1986, which says that the primary schools do not admit students to first grade unless they will attain age six by 31st Aug of the academic year in which they enter school, and students should finish the 9-years compulsory schooling until the graduation of the lower middle school.

In Netherland, Plug (2001) concluded that the older students should have longer years of schooling than younger students, because the more matured get better marks have fewer difficulties in school, and often achieve a higher level of education. We will follow Plug(2001) to use birth season as instrument for years of schooling.

Empirical Specifications

The Mincerian human capital earning function is employed to estimate the returns to education. The dependent variable is the natural logarithm of hourly wage rate. Two measures of education are used in this paper. One is the average years of schooling. Another measure is the educational levels, which we classify into 5 categories: college and above; professional, technical or vocational school; upper middle school; lower middle school; primary school and illiteracy or semi-illiteracy.

The square of experience is consistent with a declining return to experience and with the shape of age-earnings profiles observed in many dataset. In addition to human capital, wages are also affected by demographic factors, such as urban-rural difference, gender, marital status, and the market conditions. For example, occupation dummies show the return to technology progress, ownership dummies are added to explore the rent of State Owned Enterprise (SOE) or public sector, year dummies to reflect the deepening of economic reform,

as well as provincial dummy variables may reflect the provincial inequality in China (Fleisher et al 2009).

$$\ln W_i = \beta_0 + \beta_1 E_i + \beta_2 X_i + \varepsilon_i$$

where W_i is hourly wage rate of individual i, E_i represent education (years of schooling, or educational levels), X_i is a vector of control variables including gender dummy (male as 1), labour market experience (age – years of schooling – 6) and its square, marital status dummy (ever married as 1), ownership dummies, year dummies and provincial dummies; ε is an error term $\varepsilon \sim N(0, \sigma^2)$.

Plenty of literature mentioned the biases that may be caused principally by the endogenous nature of schooling. (see Dearden 1999a, b, and surveys of this literature in Card 1999 and Blundell, Dearden and Sianesi 2005). In our CHNS sample, endogeneity can arise from measurement error in schooling, since the schooling information is provided in levels rather than in years. Second, endogeneity can arise because of omitted ability. That is, the return coefficient β_1 is biased (upwards) because chosen schooling levels are (positively) correlated with omitted ability, while ability is (positively) correlated with the wage rate. Third, urban populations in China place more importance on academic background, and the academic background has a strong influence on individual employment, wages, and promotion. Adult education is therefore popular and positively correlated with the wage rate (Chen and Hamori, 2009). Moreover, Card (1999) argue that OLS estimates of β_1 are biased downwards because individuals with high discount rates choose low levels of schooling, that is, schooling with higher marginal rates of return.

Mcintosh (2006) argues that the most common methodology adopted to correct for such biases has been an instrumental variables approach, isolating exogenous variation in education received. For example, Harmon and Walker (1999) discuss a number of potential variables with which to instrument education choices in the UK. We adopt an IV approach and using the "piped / tap water in house or courtyard" and "birth month in June, July and August" [1] variables as instruments. Piped water represents the public investment. According to the China's compulsory education law, only aged 6 children born on or before 31st August

[1] Details of tap water see appendix B.

can be accepted as first-year primary students. Those born on 1st Sep should wait for next year. So those birth in June, July and August should be the youngest students in their cohort.

The following two-equation model describes the natural logarithm of hourly wage and years of schooling are normally applied to cope with the endogeneity of schooling:

$$\ln W_i = \alpha X_i^{'} + \beta YS_i + \mu_i$$

$$YS_i = \delta Z_i^{'} + \nu_i$$

Where Z_i denotes the vector of observed instrumental variables with the properties suggested above and the other exogenous variables, same as the variables in the above OLS regression. Our data contain two potential instruments for years of schooling YS_i: tapped water and birth month in June, July and August.

Data description and empirical results

The dataset used in this paper is the China Health and Nutrition Survey (CHNS). It is conducted by the China's National Institute of Nutrition and Food Safety, the Chinese Centre for Disease Control and Prevention, and the University of North Carolina at Chapel Hill. The survey employs a multistage random-cluster sampling process to draw households from nine administrative divisions (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong)[2]. Most households have been followed up across all five waves, but some deletions and additions have occurred based on community participation. In 1989, the CHNS surveyed 15,917 individuals from 3,795 households. Sample sizes are relatively similar across waves. Beginning in 1993 and continuing through subsequent waves, the survey added new households in the sample areas that were formed by individuals included in the previous waves. From 1997 onward, the survey added new households and communities to replace those that were no longer participating.

We use seven waves of CHNS data (1989, 1991, 1993, 1997, 2000, 2004 and 2006) to compare returns of education before 2000 and the new century. The seven sample years represent distinct phases of economic reform in China. Specifically, the year 1989 represents

2 For details of surveyed administrative divisions, please see appendix A.

the early stage of reform that started in the late 1970s, the year 1993 represents the middle stage of economic transitions after the reform re-started in 1992, and the year 1997 and 2000 are affected by the 1997-98 Asian financial crises, and by 2004 and 2006 economic transition had entered a mature stage.

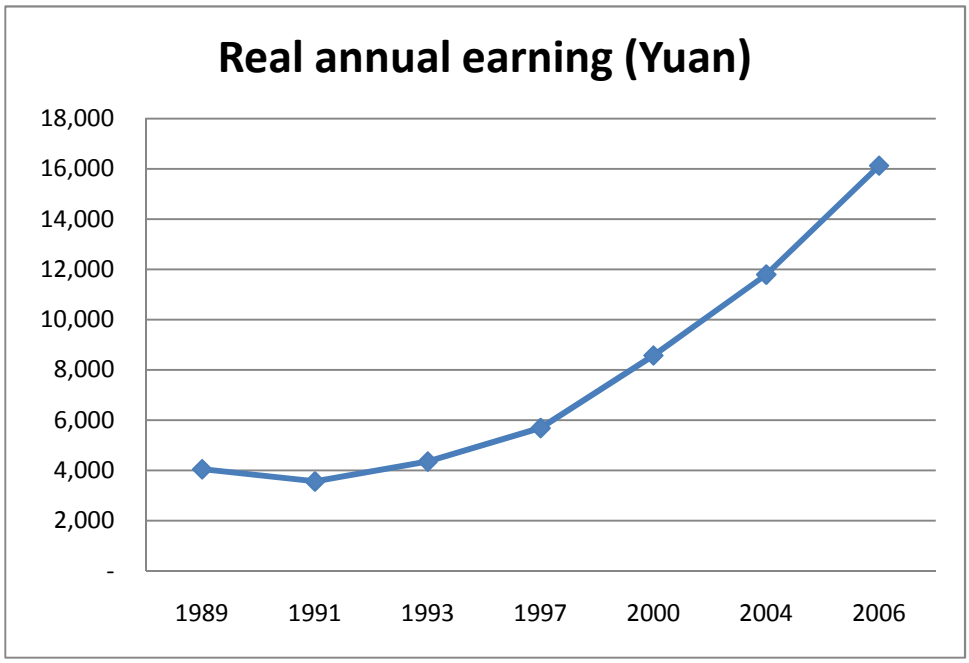
The sample used in this study is selected based on employees (age 16-60 for males and 16-55 for females, according to the age restriction for employees) who work in sectors besides "Agriculture, forestry, animal husbandry, fishery and water conservancy" sector. It only includes employees with positive annual gross income. Self-employed and owners of private or individual enterprises have been excluded, because it is difficult to separate their wages from the profit income. Earnings from the secondary job have been excluded. Observations with missing values on education, experience, etc. have been dropped.

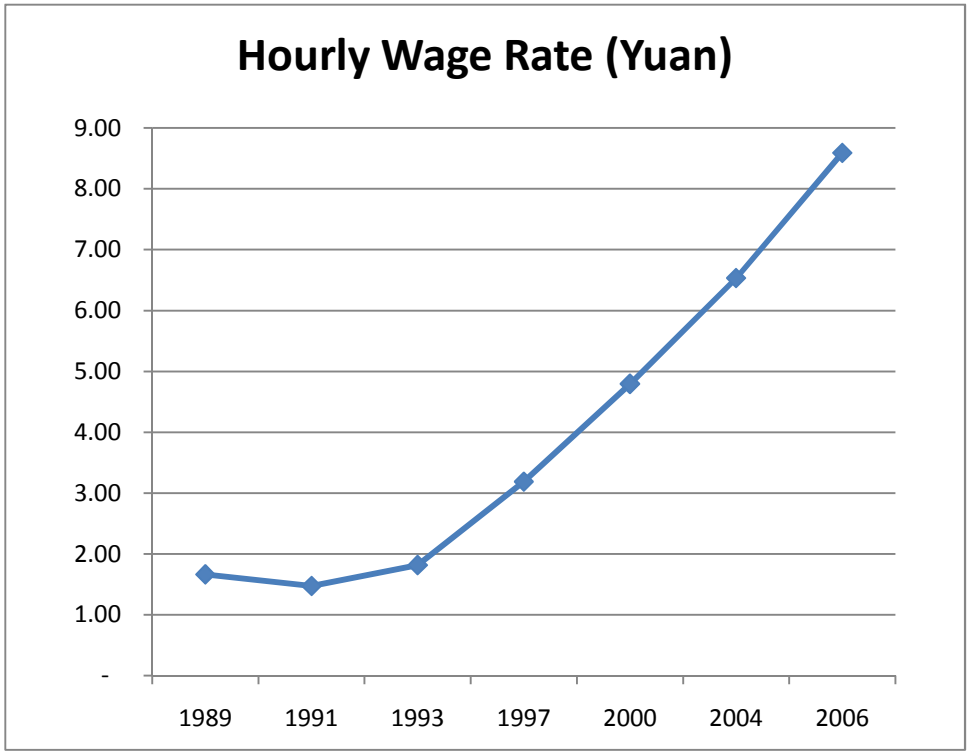
Nominal annual earnings include regular wages, bonuses, all kinds of subsidies and in-kind wages from the work unit. Nominal annual earnings are converted into real annual earnings by deflating by provincial urban and rural CPI (Consumer Price Index) with year 1995 as 100. As presented in Figure 1, annual earnings increase from 4,048 Yuan in 1989, to 5,687 Yuan in 1997, triple to 16,116 Yuan in 2006.

DeBrauw and Rozelle (2004) mentioned that previous studies may have mis-measured wages by using a wage measure that endogenizes part of the individual's decision regarding the amount of labour to allocate to off-farm work in rural China. If so, wages for the educated could be systematically understated relative to the less educated. Using data that allow for a more appropriate measure of the wage—the hourly wage instead of a daily or monthly wage—might help provide better estimates. So, we use the calculated real average hourly wage rate with the real annual earning and annual total working hours[3]. With the long working hours, the average hourly wage rate is very low in China, especially in 1989, 1991 and 1993, even below 2 Yuan per hour. It jumps to above 3.19 Yuan per hour in 1997 and doubled in 2004 at 6.53 Yuan per hour, then jumps again in 2006 to 8.59 Yuan per hour.

3 For details of annual earning and hourly wage rate, please see appendix B.

Figure 1 Trend of main variables over 1989-2006





Note: Annual earning and hourly wage rate are real values, adjusted by the provincial urban CPI (consumer price index).

Table 1 shows the data description of main variables, comparing the years before and after 2000. The average years of schooling increases from 9.05 years to 11.05 years. Among the 5 categories of education levels, the "lower middle school" level dominates the whole sample period, above 30 percent, followed by the "upper middle school" level, about 20 percent. Persons with higher education increase from 9 percent to 25 percent, and persons with vocational degrees increase from 10 percent to 19 percent. The "Primary School and below" is the baseline educational level, decrease from 18 percent to 6 percent.

The average estimated working experience is higher in the 2000s at 22.12 years, compared to 20.16 years before 2000. Half employees are from urban area and male employees are about 60 percent. About 78-86 percent employees are once married in the surveys. The ownership variable has two categories: SOE (state-owned enterprises) and public sector, private enterprises (including the collective enterprises and private or foreign enterprises)[4]. The SOE and public sector dominate across the two periods, around 57-66 percent. Nearly 83-90 percent of households have piped/tap water in house or courtyard across the surveyed period. One fourth of employees' were born in June, July or August.

[4] Details of enterprise categories please see appendix B.

Table 1: Data description

Variables	**Before 2000**	**After 2000**
Annual earning (Yuan)	4,308.72	11,621.30
Hourly Wage Rate (Yuan)	1.94	6.38
Years of Schooling (Year)	9.05	11.05
College and Above (Share)	0.09	0.25
Professional and Technical School (Share)	0.1	0.19
Upper middle School (Share)	0.22	0.21
Lower middle School (Share)	0.41	0.28
Estimated Experience(Year)	20.16	22.12
Urban (Share)	0.51	0.52
Male (Share)	0.58	0.61
Ever married (Share)	0.78	0.86
SOE or Public Sector (Share)	0.57	0.66
Private enterprises (Share)	0.04	0.15
Season of birth: Sep. - Nov. (Share)	0.28	0.28
Season of birth: Dec.-Feb. (Share)	0.26	0.27
Season of birth: Mar. - May (Share)	0.21	0.22
Season of birth: Jun. - Aug. (Share)	0.25	0.23
Having tap water (Share)	0.83	0.9
N	9,857	3,913

Note:

1. "Before 2000" includes the pooled 1989, 1991, 1993 and 1997 data; "on and after 2000" includes the pooled 2000, 2004 and 2006 data.
2. Annual earning and hourly wage are real value, adjusted by the provincial urban and rural CPI (consumer price index).

Table 2 show the OLS estimators for the years of schooling and the educational levels, with the logarithm of hourly wage rate as the dependent variable. The returns to one more year of schooling increase from 3 percent before 2000 to 7.1 percent after 2000. According to the educational levels, we find that all educational levels have significantly higher returns than the baseline "primary school and below" level, and higher level, higher return, and their return increase over time. From before 2000 to 2000s, the returns to "college and above" and "professional school" increase 34 percent and 23 percent, respectively. And, the returns to "upper middle school" and "lower middle school" increased 11 percent and 6 percent.

The patterns of the control variables are similar for years of schooling and education levels, so we analyze the years of schooling regression as example. The contribution of one more year of experience decreased 9 percent after 2000. The urban-rural gap and gender gap diminished 9 percent and 4 percent. Married employees earn 7.8 percent higher wage rate before 2000, but no statistically different from single employees after 2000. The public-private gap enlarged after 2000 to 28.7 percent higher return for the public employees.

Table 2: OLS regressions

	Before 2000	**After 2000**	**Before 2000**	**After 2000**
Years of Schooling	**0.030*** **	**0.071*** **		
	0.002	0.006		
College and Above			**0.333*** **	**0.670*** **
			0.028	0.057
Professional and Technical School			**0.204*** **	**0.429*** **
			0.02	0.049
Upper middle School			**0.142*** **	**0.254*** **
			0.022	0.051
Lower middle School			**0.073*** **	**0.131*** **
			0.019	0.045
Experience	**0.020*** **	**0.011** **	**0.019*** **	**0.012** **
	0.003	0.004	0.003	0.005
Experience square	**-0.000*** **	**0**	**-0.000*** **	**0**
	0	0	0	0
Urban	**0.219*** **	**0.131*** **	**0.216*** **	**0.125*** **
	0.035	0.031	0.035	0.031
Male	**0.132*** **	**0.089*** **	**0.129*** **	**0.106*** **
	0.01	0.018	0.01	0.019
Ever married	**0.078*** **	**-0.042**	**0.078*** **	**0**
	0.023	0.039	0.023	0.042
SOE or Public Sector	**0.125*** **	**0.287*** **	**0.115*** **	**0.259*** **
	0.027	0.039	0.026	0.035
Private enterprises	**0.203*** **	**-0.025**	**0.222*** **	**-0.033**
	0.061	0.054	0.063	0.047
R-squared	**0.327**	**0.31**	**0.343**	**0.325**
N	**9669**	**3771**	**8923**	**3679**

Note:

1. "Before 2000" includes the pooled 1989, 1991, 1993 and 1997 data; "After 2000" includes the pooled 2000, 2004 and 2006 data.
2. Hourly wage are real value, adjusted by the provincial urban and rural CPI (consumer price index).

3. The italic values are standard error adjusted for clusters in province*year (32 clusters for "<2000" data; and 27 clusters for ">=2000" data.
4. The significant levels are * for 10%; ** for 5% and *** for 1%.
5. Provincial dummy variables and year dummies are not reported.

Next, we analyze the returns to schooling with the instrumental variables estimators. In table 3, we compare the OLS and 2SLS results for the years of schooling. Different from the OLS estimators, one year of schooling has lower impact after 2000 (15 percent) than before 2000 (19 percent). And the 2SLS estimators are higher than the OLS estimators as expected. The result of the endogeneity test rejects the null hypothesis that the OLS estimates are consistent, with robust regression F test are 14.644 and 2.904. The first-stage F-statistics (19.83 and 8.52) confirm the joint significance of the two instrumentals to explain endogenous "years of schooling" volatility. Furthermore, the Score Chi2 statistics reject the two instruments are over-identified.

Returns to one year of experience become much lower after 2000 at 3 percent. The urban-rural gap disappear after 2000, may due to the huge labour migration. After 2000, female and ever married employees are in inferior situation. The 2SLS estimates show that SOE or public sectors are more attractive for workers after 2000.

Table 3 IV 2SLS regressions

	Before 2000	After 2000
Years of Schooling	**0.191*** **	**0.151*** **
	0.054	0.051
Experience	**0.036*** **	**0.017*** **
	0.007	0.005
Experience square	**0.000**	**0.000**
	0.000	0.000
Urban	**0.145*** **	**0.060**
	0.054	0.058
Male	**0.022**	**0.062** **
	0.036	0.03
Ever married	**-0.154***	**-0.122** **
	0.084	0.059
SOE or Public Sector	**-0.094**	**0.167***
	0.084	0.100
Private enterprises	**0.247*** **	**0.040**
	0.058	0.052
N	**9570**	**3762**
Exodgeneity test		
Robust regression F test	14.644	2.904
p-value	0.001	0.100
Instruments validity test		
F test	19.830	8.520
p-value	0.000	0.001
Over-identification test		
Score Chi2	0.981	0.013
p-value	0.322	0.908

Note:

1. "Before 2000" includes the pooled 1989, 1991, 1993 and 1997 data; "After 2000" includes the pooled 2000, 2004 and 2006 data.
2. Hourly wage are real value, adjusted by the provincial urban and rural CPI (consumer price index).
3. The italic values are standard error adjusted for clusters in province*year (32 clusters for "<2000" data; and 27 clusters for ">=2000" data.
4. The significant levels are * for 10%; ** for 5% and *** for 1%.
5. Provincial dummy variables and year dummies are not reported.

Conclusions

We examined the returns to schooling in China using pooled CHNS dataset of before 2000 (including 1989, 1991, 1993 and 1997) and after 2000 (including 2000, 2004 and 2006). The two instruments are valid for schooling. OLS without control for endogeneity bias may underestimate the true rates of returns of schooling. The OLS estimate of the returns to years of schooling and all education levels increase over time, but the IV estimates of the returns to schooling decrease after 2000. Other OLS conclusions still hold by using IV.

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