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Does "sheep" bring the bad luck?
The impacts of education resources on education attainment and earnings in China*[1]

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Abstract: We establish that the birth year in China is related to educational attainment because of the superstitious believes that the girls who were born in the "sheep" year will suffer bad luck, and the education system. The crude birth rate declined in the "sheep" year and schools response to the fluctuations by class size in the short run because there were no binding constraints on the class size in China. We estimate the return to education by using birth year as an instrument for schooling.

Key words: Education resources, Education attainment, Earning

1. Introduction

A handful of literature on the effect of school resources on students achievement generally finds ambiguous, conflicting, and weak results. Some researchers find that the effects of school inputs on student achievements are statistically insignificant (Coleman, 1966; Hanushek, 1986), others argue that the relation between dollars spent on education and output is positive (Hedges et al, 1994; Card and Krueger, 1996;

Krueger, 1999).

Much of the uncertainty in the literature derives from the fact that the appropriate specification-including the functional form, level of aggregation and relevant control variables are different. Many of these specification issues arise because of the possibility of omitted variables, and hence the heterogeneity problems. Krueger (1999) tried to avoid the omitted variable problems by using the experimental data from US-the Project STAR. However, the Project STAR experiment was not flawless. It might have resulted in external validity problems, including both Hawthorne effects and John Henry effects. Hawthorne effects mean that the teachers in small classes would respond to the fact that they are part of the experiment by working harder. As a result, the observed effects are not the true causal effects of small classes themselves. The class size effects would be overestimated through Hawthorne effects. The John Henry effects take place because the teachers in regular classes might provide greater than normal effort to demonstrate they could overcome the bad luck of being assigned more students. The class size effects would be underestimated through John Henry effects.

On the other hand, most literatures listed above identify the impacts of school resources on test scores. While studying the impacts of school resources on long-term outcomes such as education attainment and earnings are critical because test scores are an imperfect measure of the value of school outputs (Card and Krueger, 1996).

Researchers have to face a number of obstacles in studying the connection between school resources and economic outcomes. One difficulty is the high requirement of the data. That is the data set has to report such information as the current earnings in labor market, the completed education attainment, the family backgrounds and the information on education resources in the school they attended.

Another problem for most studies in the literature is the presence of the omitted variables that may be correlated with school quality and individual ability. One way to overcome these problems is to follow students who were exposed to dramatically different educational resources for reasons having little to do with their own ability, the schools' quality and their parents' wealth.

By using the "natural experiments" data set from North Carolina and South Carolina, Card and Kruger (1996) find a positive relationship between educational resources and educational attainments and earnings in labor markets. In order to ensure that the observed correlation between schooling and education is not due to the

correlation between schooling and ability and other characteristics, economists use IQ test (Griliches, 1977) or sample of twins (Ashenfelter and Krueger, 1994; Bonjour et al 2003) or instrumental variables to identify the return to education (Angrist and Krueger, 1991). Although most of them find that education is positively related with earnings in labor market, they have conflicting results about how the omitted ability variables bias the estimated return to schooling (downwards or upwards).

As for China, all of the researchers find that the return to education is positive and the return is increasing over time in China (Li, 2003; Zhang ea al, 2005; Hannum and Wang, 2006). All of these researches didn't take account of the omitted variable problems. Due to the access to the data, there are no studies on the impacts of education resources on education attainment.

This paper tries to fill the gap in the literature. We take advantage of the natural experiment context in China to ensure that the observed correlation between educational resources and education attainment and hence the earnings in labor market is causal effect. We will answer two questions here: (1) the impact of educational resources on education attainment; (2) the return to education. By answering the two questions listed above in the Chinese context, we can also identify how the informal social norms effect human beings' behavior and hence the economic outcomes. This paper can also identify the impacts of the informal social norms on human's behavior and hence on the economic outcomes.

The paper is constructed as follows: the second part introduces the natural experimental context in China; the third section is about data and descriptive analysis; the fourth is the impact of educational resource on education attainment; and the fifth analyzes the return to education. The last part concludes the paper.

2. A natural experiment context in China

According Chinese lunar calendar, there is a symbol animal in each year, and 12-year develops a cycle. They are rat, Ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog and pig. In Chinese tales, the people born in different animal year have different characteristics. Many Chinese parents believe their daughters who were born in the sheep year would suffer bad lucks. Given the fact that the parents don't know their child's gender until the child was born especially when the medical

gender identification technique was not mature period[2], they try to deliver the babies in the horse year or the monkey year. Although many scientists point out that it is nonsense to believe this informal social norm (Yue Feng and He Yu,2003), there exist a lot of reports about the declining birth rate in the sheep years and the increasing birth rate in its surrounding years (Taiyuan Xinhua News Agency, 2002; Xinhua News Agency, 2003; Huiqin Chen and Hao Bai, 2004；Xu Yang, 2004). Duan and Wang (2003) claimed that the declining magnitude of birth numbers in sheep year is not bigger than the other years. However, they obviously failed to explain the fact that the birth numbers in sheep year were lower than its surrounding years systematicly. And they also ignored the impacts of family planning policy on the birth numbers because they include the years of 1980, 1990,1991 and 1992 in their analysis. In order to reveal the impact of the informal social norm, we list the crude birth rate across years (see figure 1).

[figure 1]

Of course, from figure 1, we can find that the birth rate decline dramatically in 1961 due to the great famine in China. After the year of 1961, the crude birth rate kept at 30‰ or over until 1971. In 1979, Chinese government adopted the family planning policy, requiring Chinese couples to have few children. From figure 1, we can find that in the sheep years of 1955, 1967 and 1979, the birth rate declined, and from the next years, it rose again. In the year of 1991, the birth rate was lower than the previous year too. In order to disaggregate the superstitious belief effect with the one child policy, we'll focus on the years before the family planning policy was taken effects.

In this paper, we will focus on three cohorts: the cohorts from 1954 to 1956, from 1966-1968 and from 1978 to 1979. We exclude the year of 1980 from the third cohort due to the adoption of family planning policy in late 1979. We choose the three-year span as a cohort because on one hand, the parents usually advance or postpone the fertility by one year instead of many years, on the other hand, we can control the age-specific effects (are they young and inexperienced, or older and more experienced?) and period-specific effects (is the economy growing rapidly, or is it in a recession?).

In order to give clearer evidence, we compare the birth rate in the sheep year

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[2] Even when the medical gender identification technique is mature now days, the gender identification is illegal in China.

with that in its previous (horse year) and next year (monkey year). We compute a ratio i:

$$i = \frac{2r_t}{r_{t-1} + r_{t+1}}$$

Where r_{t-1}, r_t, r_{t+1} are the crude birth rates in year t-1, t and t+1 separately (see figure 2).

[figure 2]

Figure 2 shows us that in the sheep years of 1955, 1967 and 1979, the birth rate ratios are less than 1. This means that the crude birth rate in the sheep year is relatively lower than its previous and consequential years.

We also compute the first difference index, $d=r_t-(r_{t-1}+r_{t+1})/2$ to tell how the birth rate changed in the sheep year (see figure 3).

[figure 3]

Figure 3 reveals that the difference index in year 1955 or 1967 is lower than 0 significantly. Figure 2 and 3 tell us the same thing as figure 1, that is, the crude birth rate in sheep year does decline.

Current China has a public national education system. This means most of the education investment came from the national and local government, especially before the reform policy was taken place. By far, there is no regulation about the class size and the student-teacher ratio yet. This means that most schools will response to the fluctuation of birth rate by the class size, while the education investment didn't change a lot in a short period. Given the fact that there is no literature on the topic in China, we have to quote the reports from news paper to support our hypothesis. There are many reports on the impacts of the declining birth rate in the sheep year on the education from different provinces (Dong, Chuanfeng, 2009; Sun, Miao, 2009; China Youth Daily, 2009). All of the reports claim that the applicants born in the sheep year to both primary school and college are less competitive due to the declining birth rate.

The fiscal expenditure in education by years is depicted in figure 4. Figure 4 tells us that the magnitude of expenditure in education hasn't changed a lot until the year of 1978, when the reform and openness policy was launched. The expenditure in education has kept a steady share over years. Combined figure 1 and figure 4, can we find that the education expenditure didn't response to the fluctuation of population growth.

[figure 4]

This situation creates a natural experiment: the people who were born in the sheep year could consume more education resources. As a result, they were expected to have a higher education attainment. Suppose the average ability of people over years is the same, the education differential between the sheep and other years comes from the education quality, namely, the education resources per person.

The impact of education resource on education outcome is of importance issue for education policy makers. But in China, it is very difficult to get data about the class size and testing score. The return to education is also an important issue in labor economics. The critical thing is to isolate the effect of an unobserved variable-ability. The Chinese context culture offers us an unusual natural experiment with the lower birth rate in the sheep year comparative to the other years.

3. Data

The data we used are derived from China General Social Survey data (CGSS), which were carried out by Department of Sociology, Renmin University of China & Social Science Division, Hong Kong Science and Technology University. The data consist of two waves-2003 and 2005 waves. The survey covered more than 100 counties from 26 provinces. 5,900 and 10,000 households were randomly chosen in the 2003 and 2005 waves separately. The survey took place only in urban area in 2003, and extended to rural area in 2005. In this paper, we use only the samples from urban areas. There are 5,894 and 6,098 samples in the two waves.

The CGSS data collect detailed information at the individual levels, including income (both monthly and annual), education, age, marriage status, occupation and industry in which they work. We also have the detailed information at the household level, especially on education years and occupation of the parents. From the information can we estimate the impacts of education inputs on long-term education outputs, together with the natural experimental context of China.

4. Birth year and years of completed education

We use the China General Social Survey data (CGSS) to document the relationship between the birth year and the years of completed education.

[figure 5]

Figure 5 reveals that the completed years of education are increasing over years.

And the schooling year of those who were born in the year of 1955 were higher than that for those who were born in the previous year. The people who were born in 1967 have more completed education than those who were born in the surrounding years.

Due to the time series pattern, the years of completed education are increasing over years (see figure 5). We will resolve this problem by focusing on three cohorts, with 3 years as one cohort. The years of 1954, 1955 and 1956 make one cohort, 1966,1967,1968 another, the third one consists two years-1978 and 1979 due to both the great policy changes[3]. In the three cohorts, 1955, 1967 and 1979 are the sheep year. And in each birth cohort, the years of completed education in the sheep year are a little bit more than those in the horse (one preceding year) and monkey (one succeeding year) years. Another reason that we focus on the three year birth cohorts is that they would share the similar social and economic environments.

To further examine the annual pattern in education, it is useful to remove trend in years of education across cohorts. Following the approach by Angrist and Krueger (1991), we detrend the series by subtracting off a moving average of the surrounding birth cohorts' average education. For each year, we define a one period, two-sided moving average, MA(+1, -1). For the cohort of persons born in year t,

$$MA(+1, -1)=(E_{-1}+E_{+1})/2,$$

Where E-1 and E+1 are the average years of education attained by the cohort born in before or after year t. The "detrended" education is E_t- MA(+1, -1).

The relationship between birth year and years of education for the detrended series is depicted in figure 6 for each three-year-age group. The figure clearly shows that the sheep year is positively related with the completed education years[4].

[figure 6]

To quantify the effect of year of birth on education outcomes, we estimated the regression as:

$$E_t- MA(+1, -1)=\alpha+\beta\times BIRTH+\varepsilon$$

With the sheep year=1, the preceding and succeeding year of "sheep" eqeuals 0. We estimate the regression by cohorts.

[table 1]

Table 1 tells the same story as figure 6, that is, the sheep year has positive effect

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[3] The policies include both the reform and family planning policied.

[4] Due to the family planning policy, we compute the completed schooling differential in 1979 by E_{1979}-E_{1978}.

on education attainment. In the cohort of 1954-1956, those people who were born in the sheep year would stay in school about 0.361 month longer. And for the cohorts of 1966-1968 and 1977-1979, those who were born in the sheep year had completed 0.775 and 0.724 longer years of education.

5. Estimating the return to education

Does the small difference in education years for people who were born in the sheep year translate into difference in earnings? This question was addressed firstly in figure 7. Figure 7 presents a graph of the mean log weekly earnings of those who were born in the sheep years (1955, 1967 and 1979) and their surrounding years. Welch (1979) did find that the large cohorts depress earnings and most of the effect comes early in the career, because the labor market can't digest an increasingly large number of new arrivals. However in China, on one hand the birth rate in the surrounding years of "sheep" year didn't increase as dramatically as the peak-sized cohorts in the post-World War two baby boom. On the other hand, we use the earnings of 2003 and 2005 instead of the new arrivals so that they can equalize the labor market competitions across three years by mobility. As expected, except the cohort of 1978 and 1979, the log hourly earnings don't response to the birth year, see figure 7.

[figure 7]

In order to avoid the life-cycle changes, we will focus on the birth cohort separately, see table 2. In table 2, we use the yearly birth pattern in education to calculate the return rate to education based on an application of Wald's (1940) method. This estimator simply computes the return to education as the ratio of the difference in earnings by sheep year of birth to the difference in years of education by surrounding years of birth.   The Wald estimate is a special case of instrumental variables (Durbin, 1954). In this case, the Wald estimate is equivalent to instrumental variables where year is used as an instrumental for education, and there are no covariates. The OLS estimate is from a bivariate regression of the log hourly wage on years of education.

Table 2 shows that the wage rate increases with the schooling years. On average, the Wald estimates shows that the wage rate will increase about 12.85% with one more year of education. And the Wald estimates also depict an increasing return to education by time. OLS results shows that the return to education is about 6%, and the return rate keeps stable cross years. The Wald estimate results are consistent with the results from Appleton et al (2005).

[table 2]

To improve the efficiency of the estimates and control the other variables which might be related with earnings, we regress the following TSLS model:

（1） $E = a + bX + \sum_{c=2}^{3} cCOHORT + dBIRTH + \theta$

（2） $\ln W = \alpha + \beta X + \sum_{c=2}^{3} \gamma COHORT + \phi E + \varepsilon$

Where E is the schooling years of individual i, X is a vector of covariates, including the individual and family characteristics. COHORT is a dummy variable to classify which group the individual is in. There are three cohorts in the paper, and the first cohort, from 1954 to 1956 is the base group. The dummy variable of cohort is used to control the time trend in earnings. BIRTH is also a dummy variable, it equals 1 if the individual was born in the sheep year, 0 if not. W is the hourly wage. θ and ε are the residuals. $a, b, c, d, \alpha, \beta, \gamma, \phi$ are the estimated coefficients. The coefficient ϕ is the return to education.

If the residual ε is correlated with E due to the problem of omitted variable, such as ability, the OLS estimation of the return to education will be biased. We use the birth year (sheep year or the surrounding years) as the instrument variables to estimate the return to education. If the superstitious belief is national wide, the distribution of ability in the sheep year and its surrounding years are similar. The variation of education attainment across different years is identified by the birth year within a cohort. And the birth year in each cohort is related with education level due to the different level of education resource consumption, and unrelated with the residual ε. The results are listed in table 3.

Table 3 tells us that people who were born in the sheep year will have more than half a year longer completed education. The estimated return to education by TSLS is about from 9-11%, while only about 6% from OLS. The OLS estimation seemed to bias the return downwards by 3-5%.

[table 3]

6. Conclusions

Using the superstitious belief about the bad luck "sheep" year as a natural experiment, we find that the birth rate in the sheep year is lower that its surrounding years. Supposing the education resources don't change a lot in the three sequential years, the people who were born in the sheep year can enjoy the affluent education

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resources. As a result, the lower birth rate leads to a higher education attainment, and the higher education gained higher rewards in terms of earnings. The policy implications are that China should issue the regulations on class size.

The results also figure out that the informal social norms will change human beings' behavior and hence the economic outcomes. Namely, the Chinese style informal social norm, that is the superstitious belief that girl who was born in the sheep year will suffer bad luck, effects human beings' fertility behavior. They try to advance or postpone the fertility so that the babies can enjoy more educational resources and hence gain more earnings from the labor market. The babies who were considered to suffer bad luck actually consume the "sheep year" premium.

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Figure 1 crude birth rate in China by years

crude birth rate (‰)
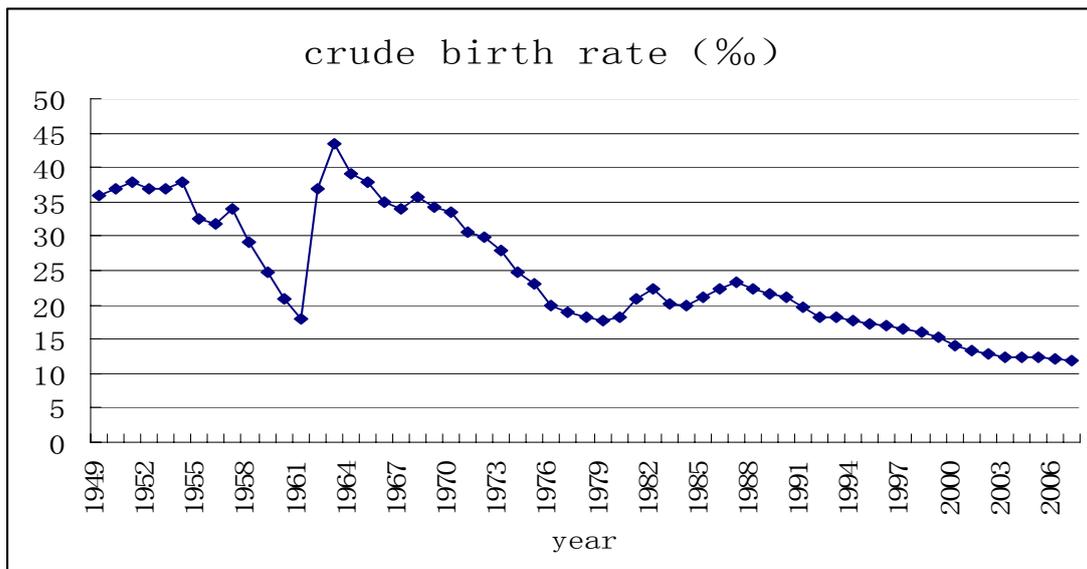
Figure 2　　Birth rate ratio in year t relative to year t-1 and t+1
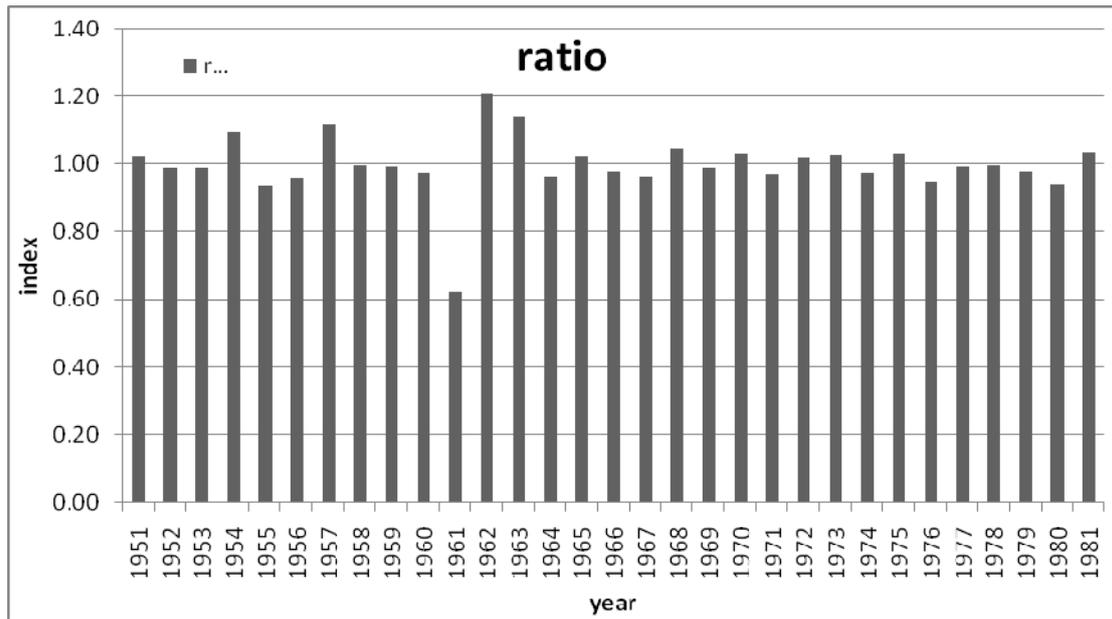
Figure 3 First difference of birth rate
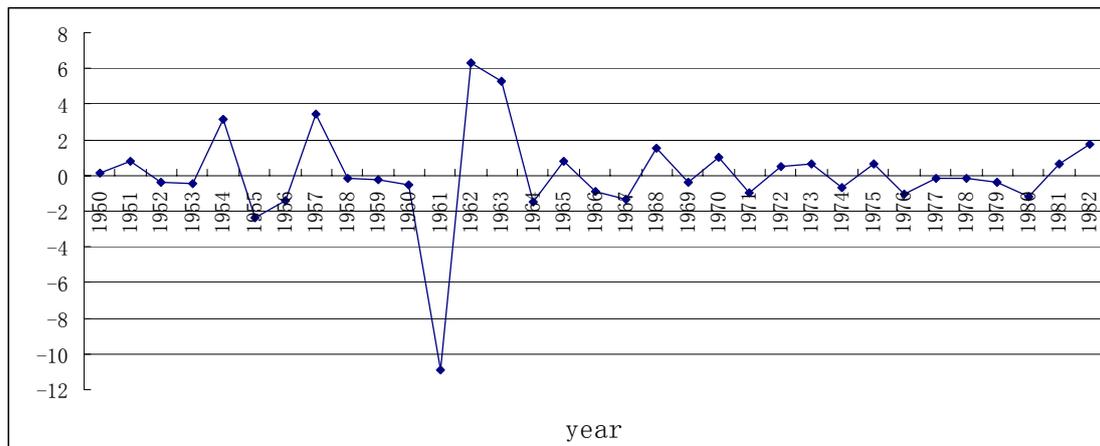
Figure 4 Expenditure in education over years
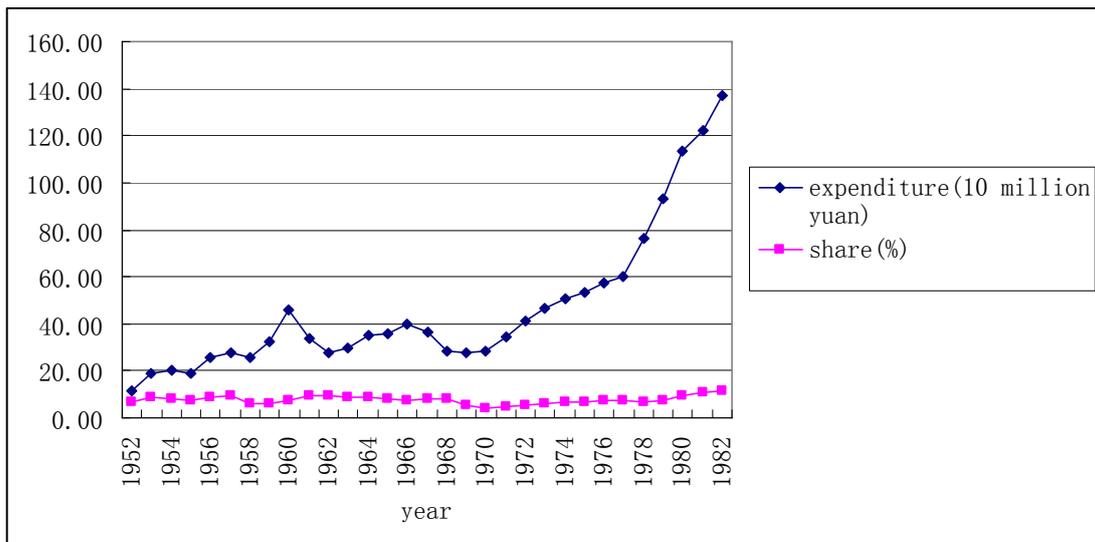

Figure 5 The completed education year by birth year
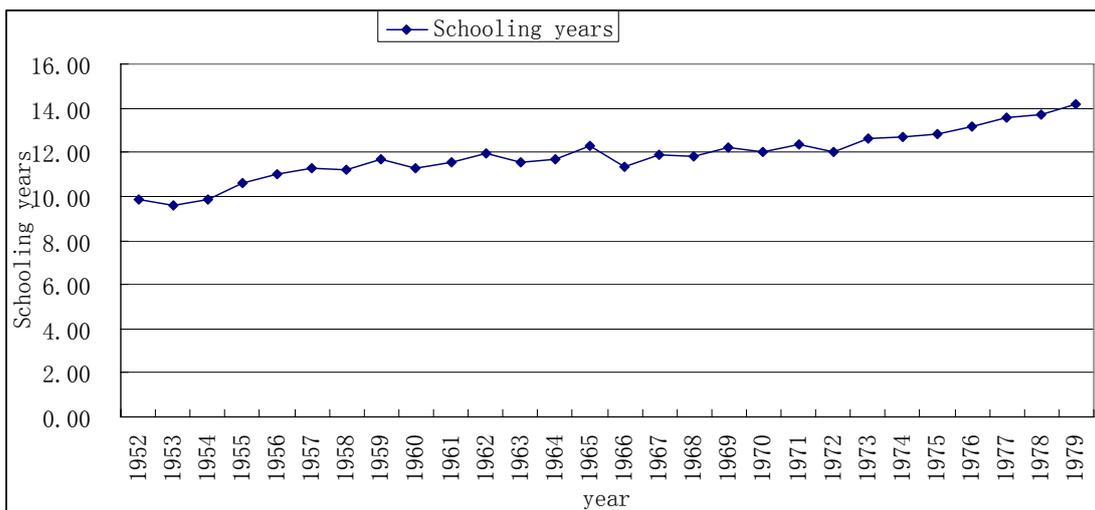
Figure 6 schooling differential over birth cohort
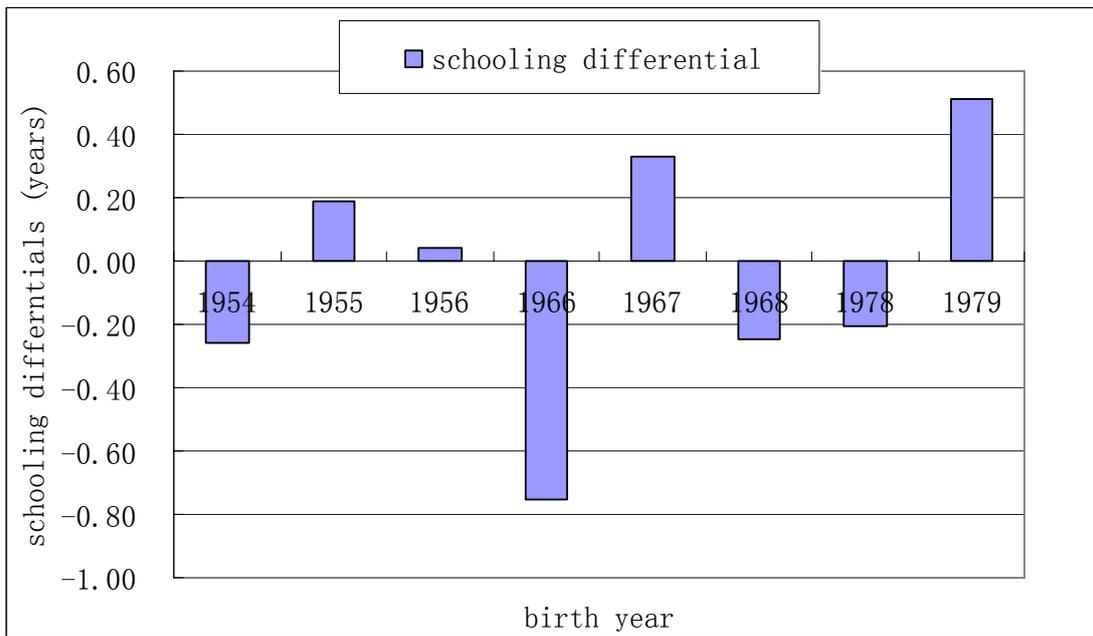
Figure 7 the log wage rate and birth year
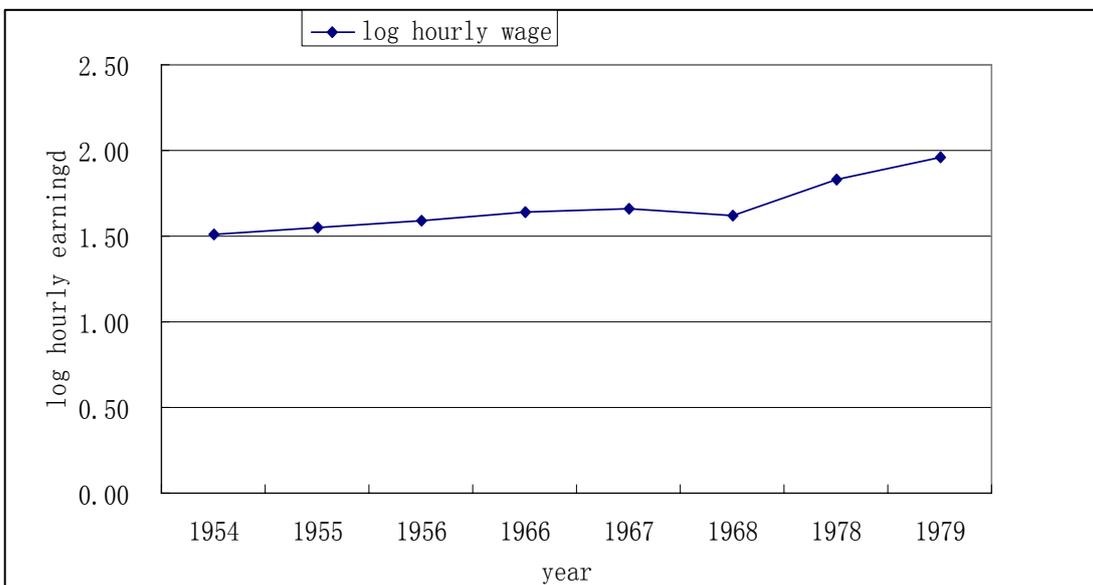
Table 1   The effect of sheep year on educational outcomes

Birth cohort	Mean of years of schooling	Sheep year effect (P-value)	F-test (P-value)
1954-1956	10.69	0.361 (0.182)	1.79 (0.182)
1966-1968	11.87	0.775 (0.007)	7.36 (0.007)
1978-1979	14.05	0.724 (0.051)	3.84 (0.051)

Table 2 Wald estimation for the return to education

	Born in the sheep year (1)	Born in the surrounding years of sheep (2)	Difference (1)-(2)
Log(hourly wage)	1.6816	1.6314	0.0502
Schooling years	11.8767	11.4861	0.3906
Wald est. of return to education			0.1285
OLS return to education			0.0667 (19.67)
Cons.			0.8736 (21.02)
Number of obs	754	1366	2120
By cohort			
Cohort 1			
Log(hourly wage)	1.5481	1.5506	-0.0025
Schooling years	10.5895	10.3906	0.1989
Wald est. of return to education			-0.0126
OLS return to education			0.0628 (11.12)
Cohort 2			
Log(hourly wage)	1.6560	1.6295	0.0265
Schooling years	11.9094	11.6132	0.2962
Wald est. of return to education			0.0895
OLS return to education			0.0626 (11.02)
Cohort 3			
Log(hourly wage)	1.9642	1.8267	0.1375
Schooling years	14.1989	13.6881	0.5108
Wald est. of return to education			0.2693
OLS return to education			0.0661 (8.46)

Note: numbers in the parentheses are t-statistics.

Table 3 OLS and TSLS estimates of the return to education

Independent ariable	OLS (1)	TSLS (2)	OLS (3)	TSLS (4)	OLS (5)	TSLS (6)
Schooling differential	0.0618*** (13.28)	0.1118 ** (2.26)	0.0618*** (13.39)	0.0871* (1.84)	0.0594*** (12.43)	0.0861* (1.60)
Marriage (1=married)	-0.1762*** (-4.08)	-0.1334 ** (-2.16)	-0.0684 (-1.43)	-0.0470 (-0.75)	-0.0665 (-1.39)	-0.0469 (-0.75)
Sex(1=female)	-0.0895*** （-2.66）	-0.0572 (-1.21)	-0.0919*** (-2.76)	-0.0755* (-1.66)	-0.0929*** (-2.79)	-0.0760* (-1.59)
COHORT(1=born in the years of 78,79)			0.2014*** (5.03)	0.2008*** (4.95)	0.1988*** (4.97)	0.2002*** (4.93)
Father's education					0.0116* (1.91)	0.0026 (0.14)
cons	2.0039*** （31.78）	1.9259 *** (19.02）	1.8580*** (26.98)	1.8189*** (18.04)	1.8246*** (25.70)	1.8119*** (23.76)
Number of obs	1284	1284	1284	1284	1284	1284
F(., 1280)	74.20	15.88	63.03	18.64	51.25	20.38
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Adj R-squared	0.1461	0.0692	0.1620	0.1423	0.1638	0.1432
First-stage regressions; Dependent variable: Schooling differential						

BIRTH(1=sheep year)		0.7526*** (3.53)		0.7588*** (3.54)		0.6689*** (3.22)
Marriage (1=married)		-0.7216*** (-2.78)		-0.7567*** (-2.62)		-0.6544** (-2.34)
Sex(1=female)		-0.6877*** (-3.43)		-0.6873*** (-3.43)		-0.6672*** (-3.44)
COHORT(1=born in the years of 78,79)				-0.0677 (-0.28)		-0.1324 (-0.56)
Father's education						0.3296*** (9.62)
cons		1.2636*** (3.30)		1.3102*** (3.13)		0.2855 (0.68)