Use of Education Disruptions to Identify Heterogeneous Returns to Schooling in Urban China: The Great Proletarian Cultural Revolution as an Instrument

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Abstract

We use disruptions to educational attainment during China's tumultuous Cultural Revolution to identify returns to elementary, middle school and post-secondary education. We make use of data from a unique survey, developed and implemented by the authors, that features information on shocks to education, and a rich set of proxies for unobserved ability (parent and sibling characteristics and a life skills test) and school quality (school location and school type) to estimate alternative OLS and IV estimates of returns to education. We find evidence of considerable heterogeneity in returns to education in China: point estimates of the return to a year of college education are 16.4 percent, while the return to a marginal year of middle school education is but 8.4 percent, and returns to a year of elementary education are insignificant with a point estimate of just 3 percent. Our findings support arguments in favor of increasing subsidies for primary and secondary education, and for developing a student loan program to support post-secondary education.

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1. Introduction

Over the course of the 1990s observers of China's developing labor market have noted dramatic increases in income inequality in urban areas, and many researchers have emphasized that a sharp increase in the returns to education over the course of the 1990s has contributed to these observed increases in inequality.[1] Data sources used for recent research, however, often lack convincing family background variables to control for unobserved ability that may cause upward bias to estimates of returns to education. Alternatively, it is also plausible that mis-measured education could be causing downward bias on the coefficient on years of education, and that actual returns to education could be even higher than those cited in recent studies. In this paper we make use of a dataset with an abundance of family background variables, proxies for school quality and direct measures of adult literacy to control for potential upward bias caused by unobserved ability. Next, we use disruptions to educational attainment that occurred during China's tumultuous Cultural Revolution to identify returns to education that might otherwise be biased by mis-measurement.[2]

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[1]Zhang and Zhao (2002) provide a useful summary of research, and results from a standard Mincer regression using repeated cross sections of the National Statistical Bureau Urban Household Survey.
[2]This paper contributes to a growing literature summarized by Card (2001) in which measurement of the causal effect of education on labor earnings is facilitated using supply-side factors as exogenous determinants of schooling outcomes. Instruments used in previous studies of the returns to education include quarter of birth (Angrist and Krueger, 1991; Staiger and Stock, 1997), geographic proximity to schools (Kane and Rouse, 1993; Card, 1995), changes in school systems or school leaving age (Harmon and Walker, 1995), special education subsidies for veterans (Lemieux and Card, 1998), and a national school expansion program (Duflo, 2002). Similar in spirit to our study, Ichino and Winter-Ebmer (1998) examine educational disruption to the 1930-35 birth cohorts in Austria and Germany who were of elementary and middle school age during World War II.

Inaccurate measurement of education may arise for several reasons. First, over the last forty years China's education system has faced dramatic changes in curriculum content, instructional format and requirements for graduation at all levels. Years of education reported in National Statistical Bureau household surveys are typically equivalent years completed, which may differ from actual years of education completed. Moreover, the value of a year of education spent learning from farmers or industrial workers during the Cultural Revolution may be somewhat uncertain, and for this reason effective years of education may be much lower for some individuals. Second, the 1980s and 1990s witnessed rapid growth in correspondence universities, television based universities (*dianshi daxue*) and evening after-work degree granting programs. Participants in these programs consider themselves full graduates with college education (and additional years of education), yet whether completion of these programs is comparable to additional years of schooling is less certain.[3]

Instrumental variables estimates presented in this paper suggest a 13.1 percent return to a year of education, which is 67 percent higher than our full-specification OLS estimate of 8.1 percent. Closer inspection of possible heterogeneity in returns to education suggests, however, that our instruments might plausibly be identifying the returns to education for individuals prevented from enrollment in college due to education supply shocks. Adding some confirmation to this possibility, we first provide OLS estimates, using a piecewise linear spline in years of education, that show an 11.5 percent return to education for individuals with more than 13 years of formal schooling.

[3]One might suspect that the share of such participants in the labor force cannot be that large, but in the random sample of urban residents used in this paper 4.5 percent of working age adults were participating in or had participated in these types of advanced degree correspondence or evening programs. This is a significant share of total working-age adults with post-secondary education.

We next explore the possibility of using education shocks at different levels of schooling (e.g., delayed start or disruptions to elementary, middle school, high school and college) to identify returns to an additional year of schooling at different levels of education. We find considerable evidence supporting heterogeneity in returns to education: if education disruption instruments are identifying local average treatment effects, then our results suggest that returns to a year of college education of 16.4 percent, while returns to an additional year of middle school education are but 8.4 percent, and returns to a year of elementary education are insignificant with a point estimate of just 3 percent.

Our results have clear policy implications regarding priorities for public funding of education. Given the low return to elementary and middle school education, our results support a case for increasing public subsidies in support of primary and secondary education. Private returns to education are high for individuals who face constrained access to universities, and this likely reflects the cost of attending university or passing university entrance examinations. Extraordinarily high private returns to post-secondary education are consistent with a shortage of college graduates, and supports arguments for expanding access to university education. Since private returns are high, however, individuals completing high school will be more willing to self-finance college education if they have a means to do so, and this suggests that developing a student loan program may be helpful for expanding access to higher education.[4]

It should be noted that one previous study (Meng and Gregory, 2002b) has also attempted to use the Cultural Revolution to study the impact of education on earnings in China. This study is limited in important ways by the data used. Meng and Gregory

[4]See Heckman (2003) for a thoughtful discussion of China's investment in human capital.

estimate a standard earnings regression using monthly wage earnings with a limited set of controls. All of the effects of the Cultural Revolution on education are based on assumed cohort differences in shocks attributed to entire urban cohorts based on year of birth. Much is lost through this approach in that it confounds differences in education quality and content across cohorts with the shock to education, and further, assumes away important variation in education shocks across urban areas.

While the Cultural Revolution was a national event of momentous scale, many of the political campaigns, including those affecting education, progressed in a highly chaotic and decentralized manner.[5] The duration and nature of education disruptions varied across cities in urban China as well as between urban and rural areas. The data source used in this study captures this variation by making use of detailed individual educational histories and a rich set of controls. We are able to construct accurate education disruption variables by city-birth cohort. Use of regional and temporal variation in shocks to education enables us to identify the returns to schooling utilizing within-cohort variation while controlling for common cohort differences. The rich set of controls further strengthens the identification strategy against possible bias.

The rest of the paper is organized as follows. In section 2, we describe the data and key variables used in the estimation. In section 3, we present evidence on the disruptive effects of the Cultural Revolution on educational attainment. Section 4 presents the estimating equations for the determinants of log wages. In section 5, we present and discuss our estimation results and conclude with a discussion of the implications of the study.

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[5]See Pepper (1996) for a sampling of case studies drawing out differences across localities.

2. Data and measurement

The China Urban Labor Survey (CULS) was conducted at year-end 2001 by the Institute for Population and Labor Economics at the Chinese Academy of Social Sciences (CASS-IPLE), working with provincial and municipal government offices of the National Statistical Bureau. All three authors collaborated in the design, training and execution of the survey. The CULS was conducted in five cities: Fuzhou, Shanghai, Shenyang, Wuhan, and Xian. The cities were chosen to provide regional diversity and variation in the size of the state versus private sectors. Fuzhou and Shanghai are coastal cities, Shenyang is in the northeast, Wuhan is in central China, and Xian is in western China. Three of the cities are among China's six largest cities by population, and another ranks tenth. The survey produced a representative sample of 700 households with local urban permanent residence permits in each of five cities.[6] All summary statistics and regressions using the pooled sample employ weights based on the sampling rate in each city as well as the number of adults in each individual's household. Each household head was asked questions about the family, and then all family members above age 16 who were no longer in school were interviewed individually. Across the five cities we completed 8109 individual education and work history surveys of these adults. Of these 8109 individuals, 5787 were younger than mandatory retirement age, and 4238 were employed at the time of the survey and provided wage and annual bonus information. We do not deal with selection into employment in this paper and estimate returns to education

[6]Within each city, a three-stage proportional population sampling approach was used to sample an average of 15 registered urban households in each of 70 neighborhood clusters (for details, see Giles, Park, and Cai, 2003) or a discussion of survey protocol on Giles' website (http://www.msu.edu/~gilesj/Protocol.pdf). The survey had a non-response rate of 16.5 percent, of which 6.5 percent of households could not be found, 4.9 percent had moved, and 5.1 percent refused to be interviewed. This refusal rate compares favorably with the first round refusal rates of two influential surveys from transition and developing countries: the Russian Longitudinal Monitoring Survey (RLMS) and the Indonesia Family Life Survey (IFLS).

conditional on current employment. In addition, by focusing on those with permanent urban resident permits only, the survey excludes those with temporary residence permits or with no registration status, a group consisting primarily of rural migrants. China maintains a household registration (*hukou*) system that determines access to employment and many social services and benefits.[7] In the 2000 Population Census, registered urban households comprised 76 percent of those living in the five sample cities.

The CULS survey instrument asks detailed questions about workers' educational histories. It records the year in which each level of schooling began (primary, lower secondary, upper secondary, vocational high school, college, vocational college, three-year college, graduate school), the years of schooling completed at each level, and a self-assessment of how many years of schooling were interrupted while enrolled at each level. By looking at the difference in the year of entry at different levels of schooling and the number of years completed (including repeated grades), it is possible to calculate the number of years of schooling missed at each level. The data thus enable us to calculate multiple education disruption variables discussed in section 3 below.

The questionnaire also included several questions on the quality of each level of schooling. These include information about where the school was located (city, county, town, village); the school's province; and whether the student was in a public magnet school, an accelerated class in a normal public school, a regular public school class, or a private school. Detailed questions also were asked about the parents of the respondent,

[7]The CULS included a separate survey of migrants, but the data from that survey are not used in this study.

including educational attainment, primary industry of employment, occupation, and socialist class background.[8]

One year after the initial CULS, a second survey of all individuals was conducted to follow-up on employment outcomes and to administer 30-minute adult literacy exams. The literacy exam was designed to test practical skills in three categories: prose literacy, document literacy, and quantitative literacy. The test was based on the International Adult Literacy Survey (IALS), which has been administered in numerous developed countries, and which we explain in greater detail in an appendix. The literacy test score provides an independent and comparable measure of skill level. Inclusion of IALS scores in wage regressions provides an additional control for unobserved differences in ability and/or skill level.

3. Education Disruptions and the Great Proletarian Cultural Revolution.

In 1966, Mao Zedong initiated a radical political campaign that incited millions of Chinese citizens to revolutionary struggle against those deemed to have betrayed China's Communist revolution. One of the consequences of the ideological furor of the Great Proletarian Cultural Revolution, which lasted until Mao's death in 1976, was widespread disruption of formal education in urban areas. Normal elementary and secondary education was severely disrupted for at least six years, and for much of the period from 1966 to 1968 schools in many urban areas were closed altogether. Most universities were closed for six years and did not return to merit-based enrollment of students until 1977

[8]Socialist class background was assigned to parents in the 1950s as efforts began to promote equity of recruitment into both administrative positions, and education opportunities for children. The categories of "bad" backgrounds were further expanded in the 1960s. Deng and Treiman's (1997) summary of the class background categories is shown in appendix Table A1. In the analyses of this paper, we assign a dummy of "bad" class background to individuals with a parent in either the "middle" or "bad" categories.

(Meng and Gregory, 2002a). Disruptions were worse for children with parents who had a bad political class background, and even those with a "middle" background may have felt the impact of quotas favoring children of "poor farmer", "worker" and "revolutionary" backgrounds for admission into middle school, high school, and universities (when they resumed operation) (Deng and Treiman, 1997). These disruptions to education had long-lasting consequences for those who were school-age children during these critical years. For no other reason than the unlucky timing of birth, schooling was delayed or cut short, and this affected future career trajectories and income-earning ability.

Calculation of Disruptions to Education. The education histories provided in the CULS include multiple ways in which individual disruptions to education may be measured. First, an explicit question asks respondents how many years of schooling at each level (primary, middle, high school, university) were interrupted by turmoil during the Cultural Revolution decade (from 1966 to 1976). Second, disruptions to schooling may be calculated from recorded start dates for each level of schooling and number of years required and actually spent at each level of schooling. These calculated gaps will pick up disruptions to education at the previous level or delays entering the next level.

From estimated individual disruptions, we calculate city-wide birth cohort average disruptions to education. We are concerned that recollection of education disruptions may be correlated with individual ability or with attitudes toward the individual's own life outcome, and for this reason, the cohort average disruption that we assign to each individual is calculated as an average over all other members of the city-cohort. Due to concern about possible biases introduced by small city-cohort cell size for younger birth cohorts (evident in the top panel of Figure 1), we calculate average city-cohort education disruptions as a three year moving average. Thus we assume that individual *i* born in year *t* in city *j* faces an average education disruption equal to the average disruption observed in responses of other residents born in years *t-1*, t, and *t+1* in city *j*.[9]

In the present version of the paper we do not worry about potential biases introduced by mixes of native born and non-native legal urban residents in the CULS sample cities. Given that education shocks differed between rural and urban areas, it is possible that this will be relevant for interpreting our results and even understanding our instruments. The lower panel of Figure 1 shows considerable difference in the native/non-native mix across the five cities. For cohorts born in the 1950s, the great majority of the Shanghai sample were born locally, while for Xian and Fuzhou, a much higher share of residents were born in another city, town or rural area. Shanghai, and to a lesser extent Shenyang and Wuhan, were key cities that strongly restricted in-migration through legal residence transfer during the early careers of these birth cohorts. In the presentation below, we nevertheless calculate education disruptions across entire cohorts because most in-migrants came from towns and cities in the same province and we assume, for now, that similar shocks occurred within each province.[10]

<u>Disruptions to Primary and Secondary Education</u>. Average years of city-cohort education disruptions for elementary, middle and high school are shown in Figures 2, 3 and 4. Obvious in each of these figures are both a pronounced increase in years of education

[9]We find that the results of our analysis are robust to using education shocks for year *t* cohorts as an alternative to the three cohort average.
[10]We will examine the robustness of our results to this assumption later.

disruption for birth cohorts in each level of school during the Cultural Revolution and distinct differences across cities in the duration of average education disruptions. Given that the Cultural Revolution decade ended in 1976, the decline in education disruptions by the 1969 cohort for elementary school, and by the 1966 cohort for middle school are consistent with our expectations about the shocks to the education system during this decade. It is somewhat curious, however, that birth cohorts as old as 1952 for elementary school and 1948 for middle school are reporting interruptions to education at these levels during the Cultural Revolution. There are several factors that may be at work here. First, earlier political and social events (the Anti-Rightest Movement and Great Leap Forward) led to delays in the start of primary education for some students. Second, the Socialist Education Movement, initiated in 1964, may be confounded with the Cultural Revolution in the memories of affected individuals.[11] Since participation in this earlier movement was also determined on a school-by-school basis and exogenous to the individual and his or her family, we do not consider it problematic that shocks from this earlier program may be included in our analyses. We may more accurately think of these disruptions more broadly as caused by the Cultural Revolution and other political movements occurring from 1957 onward.

<u>Average Delay in Start of Post-Secondary Education</u>. Colleges and Universities in China were closed between 1966 and 1972, and upon re-opening family political class background status was used as an important determinant of eligibility for admission. Children of intellectual families or of non-intellectual entrepreneurial class backgrounds

[11]In China's schools the Socialist Education Movement was something of a warm-up for the Cultural Revolution. This was a trial run of education reform that emphasized sending school children to learn from farmers and factory workers. Key cities such as Shanghai were at the vanguard of this movement.

were not eligible for admission until the return of merit-based competitive entrance examinations in 1977. Until 1981 members of the "rusticated youth" returning from years in the countryside were permitted to take part in competitive examinations for college entrance. From individual education histories we calculate the delay in start of post-secondary education for each cohort as the average difference between ages at which cohort members started post-secondary education and 18. We use the 18th birthday rather than high school graduation because some rusticated youth took and passed college entrance examinations without first attending high school.

We show the distribution of the average delay for start of post-secondary education in Figure 5. We calculate this average in the same manner as the other averages above over those individuals who have actually attended a four year college, a three year college, or a post-secondary three-year technical college. We interpret the city-cohort delay times for those who entered college as picking up differences in the supply of post-secondary education for all members of the city - birth year cohort.

Share of Cohort Attending Post-Secondary Education. Another measure of city-birth cohort differences in supply of post-secondary education is provided in Figure 6. Here we show average shares of each city-birth year cohort who have ever attended formal post-secondary education. Each city shows a decline in share attending post-secondary education as we approach the birth-year cohorts affected by the Cultural Revolution and then a sharp increase for birth cohorts born after 1964 (and affected by expansion of education opportunities after 1980).

The correlation between years of education and city-cohort average years of interruption to schooling is shown in Table 1. We see that average duration of interrupted education for a city-cohort is negatively related to an individuals years of schooling. Interruption of middle school and average cohort delay in starting post-secondary education are most strongly negatively correlated with years of education. A positive correlation among disturbances to education is also evident. Average cohort interruptions during elementary years are positively correlated with average cohort disruptions in later years, and interruption of middle school education is most strongly correlated with average delays starting post-secondary education. Further, the strongest negative correlation between average share of cohort attending post-secondary education and earlier education disruptions occurs for interruptions during middle school. This likely occurs because many disruptions to middle school reduced likelihood of attending high school and taking the courses necessary to pass college entrance examination when they were once again offered on a competitive basis.

Understanding the relationship between education and average city-cohort education disruptions is perhaps best represented in a multivariate framework by looking directly at the first stage regression of the IV model we will use to study returns to education. In (1) below, we regress years of schooling for individual *i* of birth cohort *t* from city *j* on measures of experience and experience squared (E and E^2), family background controls (F), proxies for school quality (Q), literacy test scores (L), city dummy variables (γ) and birth-cohort dummy variables (λ).

$$S_{itj} = \alpha_0 + \alpha_1 E_{itj} + \alpha_2 E_{itj}^2 + D_{-itj}\alpha_3 + F_{itj}\alpha_4 + Q_{itj}\alpha_5 + \alpha_6 L_{itj} + \sum_{j=2}^{J}\gamma_j + \sum_{t=2}^{T}\lambda_t + \varepsilon_{itj} \qquad (1)$$

Inclusion of common birth-cohort dummy variables allows us to control for common cohort effects that occurred throughout urban China during the life of the particular birth cohort, and city dummy variables control for different city effects on levels of schooling. The coefficient on average disruptions to other members of the birth cohort in the city, D_{-itj}, will pick up the effects of shocks to education supply within the particular city and faced by cohort t, while all other generational effects experienced by the birth cohort will be controlled for by the cohort dummy variables, λ_t.

Results from model (1) with various average cohort disruptions are shown in Table 2 suggests that these negative correlations between disruptions to education and years of education remain when we control for all other covariates in the first-stage regression. Average disruptions occurring during middle school appear to have the strongest long-term impact as an additional average year of middle school disruption for a cohort contributes to a decrease in total years of education of more than one year. Disruptions to middle school education reduce the likelihood that students will eventually enter high school. In Shanghai, for example, only 20 percent of the 1953 birth cohort ever enrolled in high school, while 40 percent of the 1949 cohort completed high school, a high school completion rate not achieved again in Shanghai until the 1959 birth cohort. When all five instruments are included together in specification (6), they are jointly significant.

4. Estimating the Returns to Schooling

Starting with a standard Mincer-type wage regression, we estimate the log wage of individual *i* in birth cohort *t* in city *j* (W_{itj}) as a linear function of years of schooling

(S_{itj}), years of experience (E_{itj}), and years of experience squared (E_{itj}^{2}). Because of substantial evidence that China's urban labor markets are not well-integrated across regions, we include a set of city fixed effects (γ_j) in all of the regressions. Thus, we start with an ordinary least squares regression of the following equation:

$$W_{itj} = \beta_0 + \beta_1 S_{itj} + \beta_2 E_{itj} + \beta_3 E_{itj}^2 + \sum_{j=2}^{J} \gamma_j + \varepsilon_{itj} \tag{2}$$

Here, the estimated parameters are the β_k and γ^r, and the error term ε_{itj} includes unobserved ability, unobserved experience, and other idiosyncratic error and unobservables affecting wages. The main parameter of interest is β_1, the wage return to an additional year of schooling.

To better isolate the return to schooling, we first add regressors to control for unobservables that are likely to bias our estimates. These include a vector of school quality variables (Q_{itj}), a vector of family background controls (F_{itj}), and the adult literacy test score normalized in terms of standard deviations from the mean (L_{itj}). Finally, since there are likely to be important cohort effects on wages that are correlated with educational attainment outcomes, we include a set of cohort fixed effects (λ_t). Adding these to (2), we have:

$$W_{itj} = \beta_0 + \beta_1 S_{itj} + \beta_2 E_{itj} + \beta_3 E_{itj}^2 + F_{itj}\beta_4 + Q_{itj}\beta_5 + \beta_6 L_{itj} + \sum_{j=2}^{J} \gamma_j + \sum_{t=2}^{T} \lambda_t + \varepsilon_{itj} \tag{3}$$

Instrumental Variables Estimation

As discussed in section 3 above, our instruments for years of schooling are city-cohort mean years of educational disruption for all other cohort members, (D_{-itj}), measured by missed years of schooling at different levels, delayed start of post-secondary education, and average share of city-birth cohort ever enrolled in formal post-secondary education. The validity of using city-cohort variation in educational disruption to identify the returns to schooling relies on the assumption that any cohort differences that affect wage outcomes independently of their effect on education (e.g., through cohort differences in attitudes or work experience trajectories) are the same across cities. If cohort differences in unobserved productivity differ by city in a way that is correlated with educational disruption, then the cohort fixed effects will not control adequately for possible bias.

5. Results of OLS and IV Models

We present OLS estimates in Tables 3 and 4. In Table 3 start with a base model in column (1) and add different proxies for unobserved ability correlated with family background, school quality and unmeasured dimensions of ability picked up by the international adult literacy test. Parent background variables include parent years of education, a dummy if a parent had a bad political class background (e.g., if a parent was himself or was a descendent of a landlord, rich farmer, capitalist, small factory or shop owner, counter-revolutionary or intellectual), parent industry, occupation and work-unit type dummy variables. Parent background variables are jointly significant in all OLS and IV models in which they are included. Controls for school quality include dummy variables if the individual's elementary, middle or high school is located in a county, or town or village. Given that selection likely occurs because higher ability individuals may have been able to in-migrate from smaller cities, towns or villages, we do not wish to interpret the coefficients on these school location dummy variables, yet we include them to control for differences in education quality and differences in ability correlated with ability to migrate into the city.

Results shown in Tables 3 suggest that adding family, school quality, and test scores to OLS models may in fact reduce unobserved ability bias in these models. It is somewhat surprising that the standardized average IALS score does not lead to more of a reduction in point estimates of the return to an additional year of schooling. The significant coefficient on the normalized score suggests that there may be important dimensions of ability not picked up by years of education that have consequences for earnings ability.

Given the different life experiences of cohorts and the increasing levels of education of younger cohorts, one might be concerned that some unobserved ability may be cohort specific and correlated with level of education attainment. For this reason, we include birth cohort dummy variables in models shown in Table 4. As one might expect, we then see further declines in the coefficient on years of education, suggesting that cohort specific unobservable effects may also lead to upward bias to OLS estimates.

All of our included proxies, however, do not necessarily control for the possibility that effective years of schooling may be mis-measured as a result of non-reporting of education disruptions, individuals reporting years commensurate with degree levels, or significant differences in education quality across schools. We employ education disruption instruments described above as instruments to correct for downward bias caused by mis-measurement, and find (in Table 5) that the estimated returns to a year of schooling rise significantly to 13.3 percent in the base specification, and to 13.1 percent in our preferred specification with a full set of controls (model 4, of Table 5).[12] If our instruments are correcting biases caused by error in the measurement of years of education, then this finding suggests returns to education continued on the upward trend demonstrated in the annual estimates from 1988 to 1999 presented in Zhang and Zhao (2002).

Another explanation for the observed increase in the IV estimate over the OLS estimate might be the existence of underlying heterogeneity in the returns to education, and the likelihood that our IV estimates identify marginal returns for a subset of individuals facing higher than average costs for a marginal year of education. If our education disruption instruments identify individuals who have higher than average costs of an additional year of education, then our IV estimator may be identifying returns for a sub-group of the population with higher marginal returns to education than the average marginal return to education. In the returns to education literature in the US, such instruments as compulsory education through age 16 or accessibility of schools, identify returns for individuals who would otherwise have lower levels of education. Card (2001) suggests use of such education supply variables as instruments are identifying a local average treatment effect, and will lead to estimated returns to education above the average marginal return to schooling in the population. In the China setting, the sheer difficulty of testing into university and outright restrictions on college entrance during the

[12]The returns to ability shown in columns 5 through 8 of Table 5 are now insignificant, but we should be careful about interpreting these because IALS test scores may be influenced by shocks to education as well and, for this reason, treated as endogenous. None of our education disruption instruments are significantly correlated the IALS test scores, so we do not have valid instruments.

Cultural Revolution, means that individuals effectively face much higher marginal costs for additional years of education at higher levels of attainment. Rather than identifying the returns to education for individuals who would otherwise achieve fewer total years of schooling, the instruments that we use likely identify returns to education for individuals who would have higher levels of schooling if binding constraints were removed.

6. Heterogeneity of Returns to Education.

In order to investigate the possibility that our instrument might be identifying marginal returns for a subgroup of the population, we run OLS regressions once again but with a piecewise linear spline in years of education. In the specification with a full set of controls (Table 6, Column 8) the average marginal return to a year of education equals 11.5 for individuals with 13 or more years of education, and only 5.1 and 6.7 percent for individuals with less than 9 and 9 to 11 years of education, respectively. Inspection of these results suggests that there may indeed be considerable heterogeneity in returns to education in urban China, and that our IV may be estimating the return to marginal years of post-secondary education.

While OLS results using a linear spline suggest the presence of considerable heterogeneity, estimates at different levels of education may continue to be subject to considerable measurement error bias. Recalling the strong negative correlation between average city-birth cohort education disruptions and average cohort enrollment in college (discussed in section 3), it seems likely that our instruments in the full specifications shown in Table 5 are identifying the returns to post-secondary education. Since average disruptions and delays at each level of schooling are correlated with potential advancement to the next level of schooling, it is also conceivable that we may use instruments independently to identify returns to education at different levels of educational attainment. Our results, shown in Table 7, further suggest considerable heterogeneity in returns to education in China. If we interpret the instruments used as identifying marginal returns to a years of elementary, middle school and post-secondary education, respectively, then we fine the return to a year of college education 10 be 16.4 percent, while the return to a marginal year of middle school education is but 8.4 percent, and returns to a year of elementary education are insignificant with a point estimate of just 3 percent.

Such considerable heterogeneity in returns to education has clear implications regarding priorities for public funding of education. Given the low return to elementary and middle school education, our results support a case for increasing public subsidies in support of primary and secondary education. Private returns to education are high for individuals who face constrained access to universities, and this likely reflects the cost of attending university or passing university entrance examinations. Extraordinarily high private returns to post-secondary education are consistent with a shortage of college graduates, and supports arguments for expanding access to university education. Since private returns are high, however, individuals completing high school will be more willing to self-finance college education if they have a means to do so, and this suggests that developing a student loan program may be helpful for expanding access to higher education.

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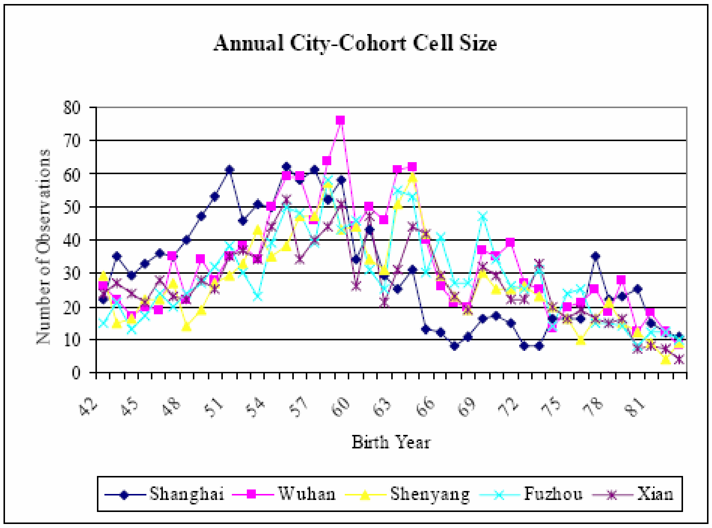
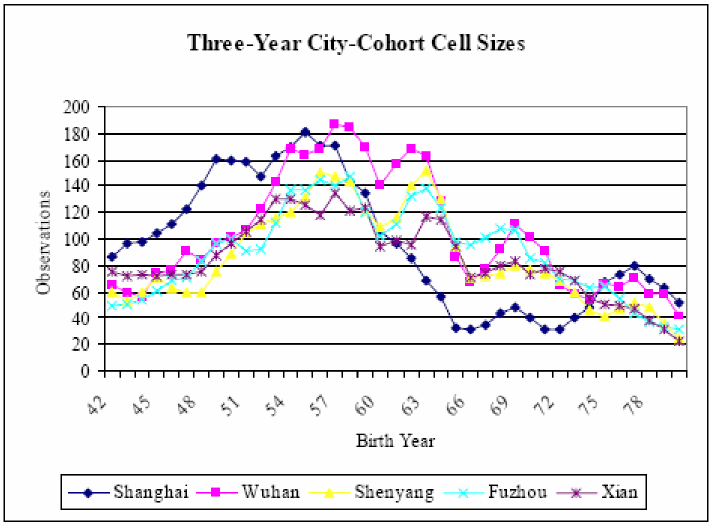
Figure 1
City-Cohort Cell Sizes





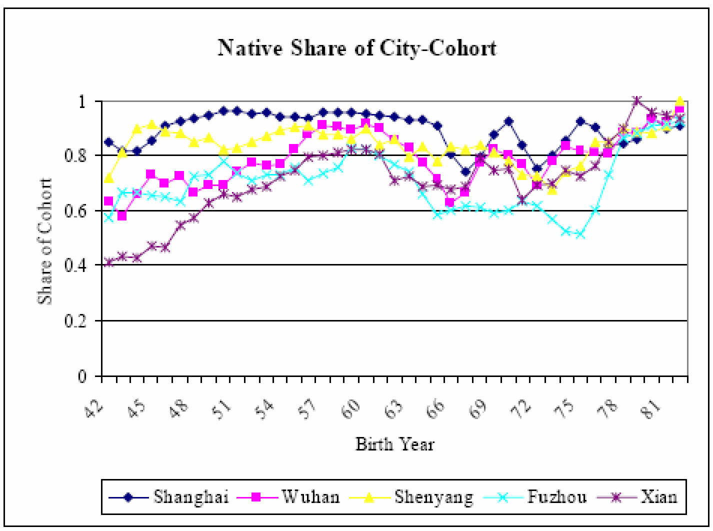


Figure 2
Average Years of Disruption During Elementary School
By City and Birth Cohort

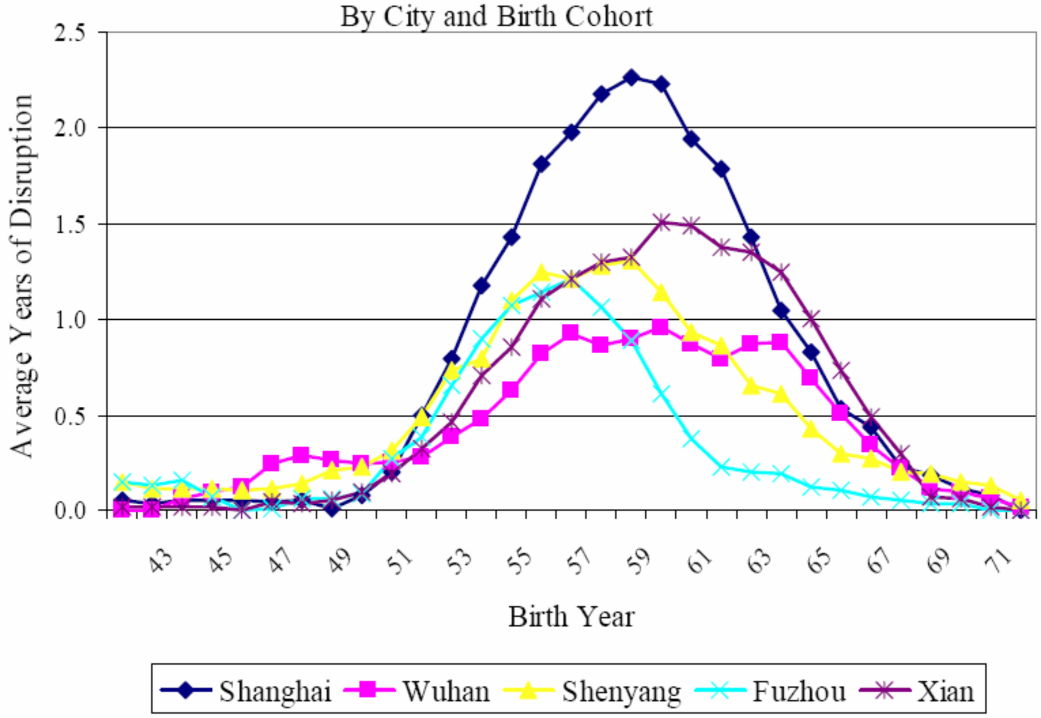


Figure 3
Average Years of Disruption During Middle School
By City and Birth Cohort

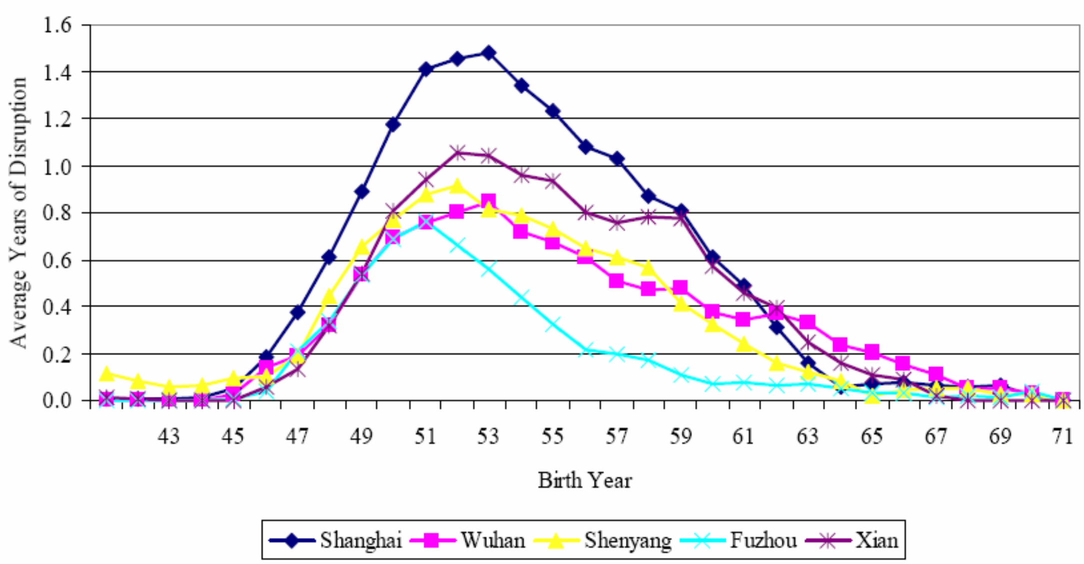


Figure 4
Average Years of Disruption During Highschool
by City and Birth Cohort

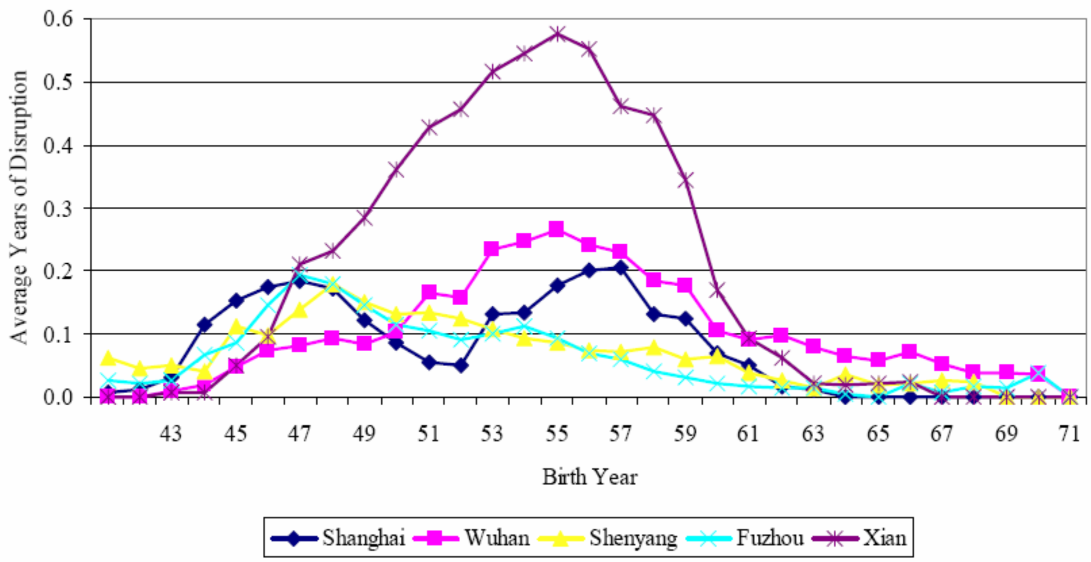
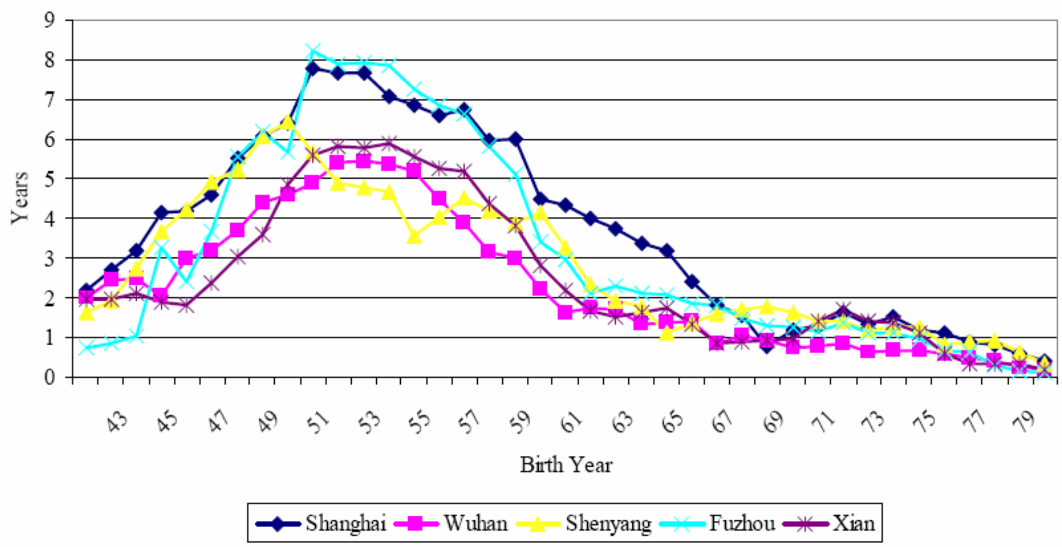
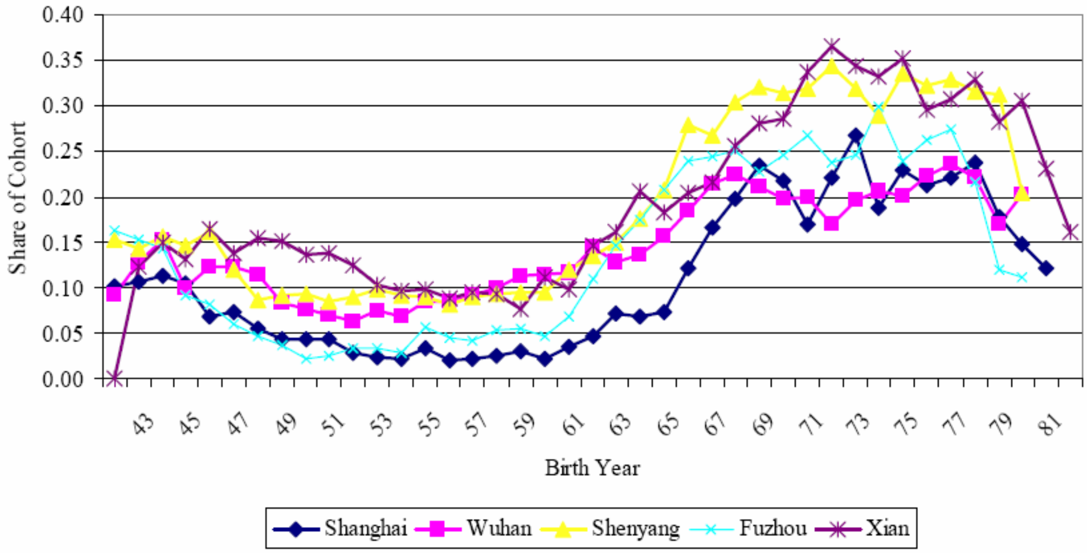


Figure 5
Average Delay in Start of Post-Secondary Education
By Birth Cohort and City



Average delay in start of post-secondary education. We exclude participation in remedial, correspondence and television based programs.

Figure 6
Share of Birth Cohort Ever Attending Post-Secondary Education
By City



We show the share with education from enrollment in technical colleges, three year colleges and regular four-year college programs. Individuals with degrees from evening remedial, television-based or correspondence programs are not included.

Table 1
Correlation of Disruptions to Education and Years of Education

	Years of $Education_i$	Interrupted Elementary Education[a]	Interrupted Middle School Education[a]	Interrupted Highschool[a]	Delay Starting Post-Secondary[a]	Post-Secondary Education[b]
		City Residence - Birth Cohort Average:				
Years of $Education_i$	1.000					
City Residence - Birth Cohort Average:						
Interrupted Elementary Education[a]	-0.127	1.000				
	(0.000)					
Interrupted Middle School Education[a]	-0.198	0.562	1.000			
	(0.000)	(0.000)				
Interrupted Highschool[a]	-0.087	0.360	0.570	1.000		
	(0.000)	(0.000)	(0.000)			
Delay Starting Post-Secondary[a]	-0.259	0.333	0.769	0.479	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)		
Post-Secondary Education[b]	0.288	-0.487	-0.625	-0.404	-0.712	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

[a]Average years of interruption or delay calculated across city residence - birth cohorts t-1, t and t+1 for all individuals other than individual *i* from city birth year cohort *t*.

[b]Average share of city residence - birth year cohort t-1, t and t+1 with post-secondary education from regular degree program, excluding individual *i* from birth cohort *t*.

Table 2

Shocks to China's Education System and Years of Educational Attainment

A First Stage Regression for Instrumental Variables Estimates

(Robust Standard Errors in Parentheses)

Model	1	2	3	4	5	6
DepVar	Yrs of Ed	Yrs of Ed	Yrs of Ed	Yrs of Ed	Yrs of Ed	Yrs of Ed
City-Cohort Average Years of Disruption	-0.210	---	---	---	---	0.161
During Elementary Education	(0.091)	---	---	---	---	(0.109)
City-Cohort Average Years of Disruption	---	-1.206	---	---	---	-0.860
During Middle School Years	---	(0.133)	---	---	---	(0.224)
City-Cohort Average Years of Disruption	---	---	-0.183	---	---	2.050
During Highschool	---	---	(0.439)	---	---	(0.481)
City-Cohort Average Delay of Enrollment in	---	---	---	-0.213	---	-0.041
Post-Secondary Education	---	---	---	(0.025)	---	(0.043)
City-Cohort Share Enrolled in Formal Post-	---	---	---	---	6.207	4.824
Secondary	---	---	---	---	(0.729)	(0.965)
Experience	-0.102	-0.020	-0.132	-0.031	-0.066	-0.038
	(0.025)	(0.023)	(0.022)	(0.023)	(0.021)	(0.028)
Experience Squared	0.002	0.000	0.003	0.001	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female	-0.278	-0.250	-0.288	-0.254	-0.257	-0.248
	(0.092)	(0.090)	(0.092)	(0.090)	(0.091)	(0.089)
Father's Education	0.084	0.082	0.085	0.083	0.082	0.083
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Mother's Education	0.036	0.026	0.038	0.030	0.028	0.023
	(0.017)	(0.016)	(0.017)	(0.016)	(0.017)	(0.016)
Parent with a "Bad" Class Background	0.108	0.180	0.113	0.175	0.176	0.227
	(0.148)	(0.143)	(0.149)	(0.145)	(0.144)	(0.142)
Wuhan	-0.059	-0.300	0.016	-0.436	-0.254	-0.504
	(0.132)	(0.131)	(0.129)	(0.137)	(0.130)	(0.151)
Shenyang	-0.154	-0.427	-0.109	-0.445	-0.588	-0.679
	(0.147)	(0.149)	(0.145)	(0.150)	(0.156)	(0.157)
Fuzhou	-0.867	-1.284	-0.780	-0.926	-0.981	-1.189
	(0.144)	(0.150)	(0.138)	(0.137)	(0.138)	(0.155)
Xian	0.072	-0.117	0.134	-0.247	-0.446	-0.765
	(0.130)	(0.131)	(0.145)	(0.136)	(0.145)	(0.180)
Obs	4238.000	4238.000	4238.000	4238.000	4238.000	4238.000
R-Squared	0.228	0.248	0.226	0.242	0.243	0.256

Each model includes three additional sets of dummy variables: birth-year cohort dummy variables, school quality dummy variables, and parent background (mother and father occupation, industry, work-unit ownership type) variables. Each of these sets of con

Table 3
OLS Estimates of Returns to Education
(Robust Standard Errors in Parentheses)

Model	1	2	3	4	5	6	7	8
DepVar	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)
Years of Education	0.094	0.084	0.094	0.084	0.092	0.083	0.092	0.082
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Average IALS Score	---	---	---	---	0.029	0.028	0.030	0.028
	---	---	---	---	(0.012)	(0.012)	(0.012)	(0.012)
Experience	-0.002	0.004	-0.002	0.004	-0.002	0.004	-0.002	0.004
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)
Experience Squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.194	-0.203	-0.194	-0.203	-0.195	-0.203	-0.195	-0.203
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Father's Education	---	0.004	---	0.004	---	0.004	---	0.003
	---	(0.004)	---	(0.004)	---	(0.004)	---	(0.004)
Mother's Education	---	0.010	---	0.010	---	0.010	---	0.010
	---	(0.004)	---	(0.004)	---	0.004	---	0.004
Parent with "Bad" Class Background?	---	0.101	---	0.103	---	0.102	---	0.104
	---	(0.038)	---	(0.038)	---	(0.038)	---	(0.038)
Elementary School in County	---	---	-0.113	-0.103	---	---	-0.119	-0.111
	---	---	(0.102)	(0.100)	---	---	(0.102)	(0.100)
Elementary School in Town or Village	---	---	0.026	0.056	---	---	0.028	0.056
	---	---	(0.075)	(0.076)	---	---	(0.075)	(0.076)
Middle School in County	---	---	0.173	0.181	---	---	0.180	0.186
	---	---	(0.108)	(0.106)	---	---	(0.108)	(0.105)
Middle School in Town or Village	---	---	0.027	0.046	---	---	0.027	0.046
	---	---	(0.082)	(0.081)	---	---	(0.082)	(0.081)
Highschool in County	---	---	0.008	0.022	---	---	0.006	0.022
	---	---	(0.075)	(0.077)	---	---	(0.075)	(0.077)
Highschool in Town or Village	---	---	-0.105	-0.098	---	---	-0.105	-0.098
	---	---	(0.086)	(0.089)	---	---	(0.085)	(0.088)
Wuhan	-0.494	-0.480	-0.496	-0.480	-0.485	-0.474	-0.487	-0.473
	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)
Shenyang	-0.522	-0.520	-0.524	-0.520	-0.507	-0.507	-0.509	-0.506
	(0.031)	(0.032)	(0.031)	(0.032)	(0.032)	(0.033)	(0.032)	(0.033)
Fuzhou	-0.175	-0.177	-0.181	-0.184	-0.165	-0.169	-0.172	-0.175
	(0.030)	(0.033)	(0.031)	(0.033)	(0.030)	(0.033)	(0.031)	(0.033)
Xian	-0.568	-0.566	-0.576	-0.574	-0.557	-0.557	-0.565	-0.564
	(0.028)	(0.030)	(0.028)	(0.030)	(0.029)	(0.031)	(0.029)	(0.031)
Family Background Variables Included	No	Yes	No	Yes	No	Yes	No	Yes
Obs	4238	4238	4238	4238	4238	4238	4238	4238
R-Squared	0.283	0.322	0.284	0.324	0.284	0.323	0.286	0.325

Family background variables include: mother and father occupation dummies, parent industry dummies, and parent work-unit ownership dummies. Each of these sets of controls are jointly significant in all models. Parent with a "Bad" Class Background is equal to one if a parent's family was designated as counter-revolutionary, landlord, rich farmer, capitalist, small proprietor, or intellectual.

Table 4
OLS Estimates of Within Cohort Returns To Education
(Robust Standard Errors in Parentheses)

Model DepVar	1 ln(Wage)	2 ln(Wage)	3 ln(Wage)	4 ln(Wage)	5 ln(Wage)	6 ln(Wage)	7 ln(Wage)	8 ln(Wage)
Years of Education	0.091	0.083	0.091	0.083	0.089	0.082	0.089	0.081
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Average IALS Score	---	---	---	---	0.031	0.029	0.031	0.029
	---	---	---	---	(0.012)	(0.012)	(0.012)	(0.012)
Experience	0.027	0.031	0.025	0.029	0.025	0.029	0.023	0.028
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Experience Squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.195	-0.204	-0.195	-0.204	-0.195	-0.204	-0.195	-0.204
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Father's Education	---	0.003	---	0.003	---	0.002	---	0.002
	---	(0.004)	---	(0.004)	---	(0.004)	---	(0.004)
Mother's Education	---	0.008	---	0.008	---	0.008	---	0.008
	---	(0.004)	---	(0.004)	---	0.004	---	0.004
Parent with "Bad" Class Background?	---	0.114	---	0.115	---	0.115	---	0.116
	---	(0.037)	---	(0.037)	---	(0.037)	---	(0.038)
Elementary School in County	---	---	-0.087	-0.078	---	---	-0.093	-0.085
	---	---	(0.103)	(0.102)	---	---	(0.103)	(0.101)
Elementary School in Town or Village	---	---	-0.013	0.021	---	---	-0.011	0.021
	---	---	(0.073)	(0.075)	---	---	(0.073)	(0.075)
Middle School in County	---	---	0.146	0.157	---	---	0.151	0.160
	---	---	(0.108)	(0.106)	---	---	(0.107)	(0.105)
Middle School in Town or Village	---	---	0.025	0.042	---	---	0.027	0.042
	---	---	(0.081)	(0.081)	---	---	(0.081)	(0.081)
Highschool in County	---	---	0.001	0.009	---	---	-0.001	0.009
	---	---	(0.075)	(0.077)	---	---	(0.075)	(0.077)
Highschool in Town or Village	---	---	-0.068	-0.068	---	---	-0.069	-0.069
	---	---	(0.085)	(0.089)	---	---	(0.085)	(0.088)
Wuhan	-0.524	-0.512	-0.525	-0.512	-0.516	-0.506	-0.516	-0.505
	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)
Shenyang	-0.543	-0.543	-0.545	-0.543	-0.529	-0.530	-0.530	-0.530
	(0.031)	(0.033)	(0.031)	(0.033)	(0.032)	(0.033)	(0.032)	(0.033)
Fuzhou	-0.203	-0.207	-0.205	-0.211	-0.194	-0.199	-0.196	-0.203
	(0.030)	(0.032)	(0.030)	(0.033)	(0.030)	(0.033)	(0.031)	(0.033)
Xian	-0.603	-0.599	-0.607	-0.604	-0.592	-0.589	-0.596	-0.594
	(0.028)	(0.030)	(0.029)	(0.031)	(0.029)	(0.031)	(0.029)	(0.031)
Family Background Variables Included	No	Yes	No	Yes	No	Yes	No	Yes
Obs	4238	4238	4238	4238	4238	4238	4238	4238
R-Squared	0.309	0.345	0.310	0.346	0.311	0.346	0.311	0.347

Each model includes a set of birth-year cohort dummy variables that are jointly significant. Family background variables include: mother and father occupation dummies, parent industry dummies, and parent work-unit ownership dummies. Each of these sets of controls are jointly significant in all models. Parent with a "Bad" Class Background is equal to one if a parent's family was designated as counter-revolutionary, landlord, rich farmer, capitalist, small proprietor, or intellectual.

Table 5
IV Estimates of Within Cohort Returns to Education
Average City-Cohort Disruptions to Education are Used as Instruments
(Robust Standard Errors in Parentheses)

Model DepVar	1 ln(Wage)	2 ln(Wage)	3 ln(Wage)	4 ln(Wage)	5 ln(Wage)	6 ln(Wage)	7 ln(Wage)	8 ln(Wage)
Years of Education	0.133	0.135	0.132	0.131	0.136	0.136	0.135	0.132
	(0.033)	(0.037)	(0.032)	(0.036)	(0.033)	(0.037)	(0.033)	(0.036)
Average IALS Score	---	---	---	---	0.009	0.008	0.012	0.011
	---	---	---	---	0.020	0.019	0.019	0.019
Experience	0.024	0.028	0.022	0.027	0.023	0.028	0.021	0.026
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Experience Squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.183	-0.190	-0.185	-0.192	-0.182	-0.190	-0.184	-0.191
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Father's Education	---	-0.002	---	-0.001	---	-0.002	---	-0.001
	---	(0.005)	---	(0.005)	---	(0.005)	---	(0.005)
Mother's Education	---	0.007	---	0.007	---	0.006	---	0.007
	---	(0.005)	---	(0.005)	---	0.005	---	0.004
Parent with "Bad" Class Background?	---	0.105	---	0.106	---	0.105	---	0.106
	---	(0.039)	---	(0.039)	---	(0.039)	---	(0.039)
Elementary School in County	---	---	0.003	0.011	---	---	0.008	0.012
	---	---	(0.123)	(0.119)	---	---	(0.124)	(0.121)
Elementary School in Town or Village	---	---	0.099	0.125	---	---	0.109	0.129
	---	---	(0.114)	(0.108)	---	---	(0.112)	(0.107)
Middle School in County	---	---	0.098	0.098	---	---	0.096	0.097
	---	---	(0.114)	(0.114)	---	---	(0.115)	(0.114)
Middle School in Town or Village	---	---	-0.024	-0.022	---	---	-0.027	-0.024
	---	---	(0.090)	(0.095)	---	---	(0.090)	(0.094)
Highschool in County	---	---	-0.148	-0.163	---	---	-0.161	-0.170
	---	---	(0.139)	(0.148)	---	---	(0.137)	(0.146)
Highschool in Town or Village	---	---	-0.178	-0.191	---	---	-0.188	-0.196
	---	---	(0.120)	(0.125)	---	---	(0.119)	(0.123)
Wuhan	-0.514	-0.512	-0.515	-0.511	-0.510	-0.511	-0.511	-0.508
	(0.032)	(0.032)	(0.032)	(0.032)	(0.031)	(0.033)	(0.031)	(0.033)
Shenyang	-0.531	-0.535	-0.534	-0.536	-0.525	-0.531	-0.528	-0.531
	(0.033)	(0.034)	(0.033)	(0.034)	(0.033)	(0.034)	(0.033)	(0.034)
Fuzhou	-0.166	-0.164	-0.171	-0.171	-0.159	-0.161	-0.164	-0.166
	(0.043)	(0.045)	(0.042)	(0.045)	(0.040)	(0.043)	(0.039)	(0.043)
Xian	-0.606	-0.608	-0.608	-0.607	-0.603	-0.606	-0.604	-0.604
	(0.029)	(0.032)	(0.029)	(0.031)	(0.030)	(0.033)	(0.030)	(0.032)
F-Statistic (First Stage Instruments)	9.55	8.15	10.54	8.93	9.67	8.32	10.68	9.11
F-Probability	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Over-ID Chi-Sqr Test Statistic	9.35	7.84	9.15	7.91	9.44	7.86	9.28	7.95
Chi-Sqr Probability	(0.053)	(0.098)	(0.057)	(0.095)	(0.051)	(0.097)	(0.054)	(0.093)
Family Background Variables Included	No	Yes	No	Yes	No	Yes	No	Yes
Obs	4238	4238	4238	4238	4238	4238	4238	4238

Each model includes a set of birth-year cohort dummy variables that are jointly significant. Family background variables include: mother and father occupation dummies, parent industry dummies, and parent work-unit ownership dummies. Each of these sets of controls are jointly significant in all models. Parent with a "Bad" Class Background is equal to one if a parent's family was designated as counter-revolutionary, landlord, rich farmer, capitalist, small proprietor, or intellectual.

Table 6
Heterogeneity in the Returns to Education?
Within Cohort OLS Results Using a Piecewise Linear Spline of Years of Education
(Robust Standard Errors in Parentheses)

Model	1	2	3	4	5	6	7	8
DepVar	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)
Years of Ed (GTE 0 & LT 9)	0.057	0.055	0.053	0.051	0.056	0.055	0.052	0.051
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Years of Ed (GTE 9 & LT 11)	0.069	0.068	0.071	0.071	0.065	0.064	0.067	0.067
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Years of Ed (GTE 11 & LT 13)	0.106	0.081	0.105	0.079	0.107	0.082	0.106	0.081
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Years of Ed (GTE 13)	0.121	0.118	0.121	0.117	0.118	0.115	0.118	0.115
	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)
Average IALS Score	---	---	---	---	0.031	0.029	0.031	0.029
	---	---	---	---	(0.012)	(0.012)	(0.012)	(0.012)
Experience	0.033	0.036	0.031	0.035	0.032	0.035	0.029	0.034
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Experience Squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.196	-0.205	-0.196	-0.205	-0.196	-0.205	-0.196	-0.205
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Father's Education	---	0.003	---	0.003	---	0.002	---	0.002
	---	(0.004)	---	(0.004)	---	(0.004)	---	(0.004)
Mother's Education	---	0.008	---	0.008	---	0.008	---	0.008
	---	(0.004)	---	(0.004)	---	0.004	---	0.004
Parent with "Bad" Class Background?	---	0.114	---	0.114	---	0.115	---	0.115
	---	(0.037)	---	(0.037)	---	(0.037)	---	(0.037)
Wuhan	-0.532	-0.517	-0.533	-0.517	-0.524	-0.510	-0.524	-0.510
	(0.030)	(0.032)	(0.030)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
Shenyang	-0.561	-0.556	-0.563	-0.557	-0.547	-0.543	-0.549	-0.544
	(0.032)	(0.033)	(0.032)	(0.033)	(0.032)	(0.034)	(0.032)	(0.034)
Fuzhou	-0.222	-0.219	-0.221	-0.223	-0.213	-0.211	-0.212	-0.214
	(0.030)	(0.033)	(0.031)	(0.033)	(0.031)	(0.033)	(0.031)	(0.033)
Xian	-0.610	-0.600	-0.611	-0.605	-0.598	-0.590	-0.600	-0.595
	0.028	0.030	0.029	0.030	0.029	0.031	0.029	0.031
Family Background Variables Included	No	Yes	No	Yes	No	Yes	No	Yes
Obs	4238	4238	4238	4238	4238	4238	4238	4238
R-Squared	0.309	0.345	0.310	0.346	0.311	0.346	0.311	0.347

The spline breaks the sample into four quartiles based on the distribution of years of education. We report slopes of each of the four segments. Each model includes a set of birth-year cohort dummy variables that are jointly significant. Family background variables include: mother and father occupation dummies, parent industry dummies, and parent work-unit ownership dummies. Each of these sets of controls are jointly significant in all models. Parent with a "Bad" Class Background is equal to one if a parent's family was designated as counter-revolutionary, landlord, rich farmer, capitalist, small proprietor, or intellectual.

Table 7
Can Different Instrument Sets Be Used to Identify Returns at Different Levels of Education? Disruptions at Different Levels of Education Used As Instruments
(Robust Standard Errors in Parentheses)

Model	1	2	3	4
Instrument	City-Cohort Disruption During Elementary School	City-Cohort Disruption During Middle School	City-Cohort Delay in Start of Post-Secondary Education	Share of City-Cohort with Post-Secondary Education
DepVar	ln(Wage)	ln(Wage)	ln(Wage)	ln(Wage)
Years of Education	0.030	0.084	0.173	0.164
	(0.031)	(0.011)	(0.087)	(0.074)
Experience	0.026	0.029	0.028	0.028
	(0.027)	(0.022)	(0.024)	(0.023)
Experience Squared	0.000	0.000	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Female	-0.203	-0.203	-0.181	-0.183
	(0.024)	(0.023)	(0.030)	(0.029)
Father's Education	0.007	0.002	-0.004	-0.003
	(0.004)	(0.004)	(0.008)	(0.007)
Mother's Education	0.010	0.008	0.005	0.006
	(0.005)	(0.004)	(0.005)	(0.005)
Parent with "Bad" Class Background?	0.119	0.115	0.101	0.103
	(0.039)	(0.037)	(0.042)	(0.042)
Elementary School in County	-0.074	-0.075	0.067	0.052
	(0.110)	(0.102)	(0.181)	(0.165)
Elementary School in Town or Village	-0.003	0.024	0.172	0.154
	(0.083)	(0.076)	(0.193)	(0.167)
Middle School in County	0.108	0.155	0.086	0.097
	(0.119)	(0.106)	(0.145)	(0.137)
Middle School in Town or Village	-0.007	0.040	-0.044	-0.033
	(0.104)	(0.081)	(0.137)	(0.122)
Highschool in County	0.192	0.004	-0.319	-0.288
	(0.136)	(0.084)	(0.316)	(0.272)
Highschool in Town or Village	0.058	-0.072	-0.294	-0.272
	(0.122)	(0.091)	(0.238)	(0.204)
Wuhan	-0.518	-0.512	-0.516	-0.516
	(0.033)	(0.032)	(0.034)	(0.033)
Shenyang	-0.549	-0.543	-0.530	-0.531
	(0.034)	(0.033)	(0.038)	(0.036)
Fuzhou	-0.254	-0.210	-0.133	-0.141
	(0.039)	(0.034)	(0.084)	(0.073)
Xian	-0.605	-0.604	-0.609	-0.609
	(0.032)	(0.031)	(0.033)	(0.032)
Family Background Variables Included	Yes	Yes	Yes	Yes
Obs	4238	4238	4238	4238

Each model includes a set of birth-year cohort dummy variables that are jointly significant. Family background variables include: mother and father occupation dummies, parent industry dummies, and parent work-unit ownership dummies. Each of these sets of controls are jointly significant in all models. Parent with a "Bad" Class Background is equal to one if a parent's family was designated as counter-revolutionary, landlord, rich farmer, capitalist, small proprietor, or intellectual.

Appendix
The China Adult Literacy Survey (CALS)

Researchers at Statistics Canada have helped develop International Adult Literacy Surveys that have been undertaken in a large number of OECD countries. They have created a databank of questions whose validity has been tested in multiple countries. Following the literacy classifications used in the IALS, the CALS attempts to separately identify three dimensions of life skills:

Prose Literacy**.** Prose literacy focuses on the knowledge and skills needed to understand and use information from texts that contain extended prose organized in a paragraph structure typically found in news stories, editorials, brochures and pamphlets, manuals, and fiction.

Document Literacy**.** Document literacy focuses on knowledge and skills required to locate and use information found in qualitatively different printed materials that contain more abbreviated language and use a variety of structural devices to convey meaning. These include tables, charts, graphs, indices, diagrams, maps and schematics.

Quantitative Literacy**.** Quantitative literacy refers to the ability to interpret, apply, and communicate mathematical information in commonly encountered situations. Quantitative tasks can be characterized by the computational skills required and by the problem-solving strategies used.

The Chinese team that designed the CALS considered the likely distribution of educational attainment in the Chinese urban sample. They drew appropriate questions from the IALS data bank and, as appropriate, adapted and designed questions to fit the China's cultural context. A 40-minute instrument was developed and pre-tested. Based on the pretest, a final survey instrument containing 6 extended questions and requiring 30 minutes was put together.

A few features distinguish the design of the CALS from other IALS questionnaires. First, the test instrument is much shorter (30 minutes). Second, all respondents were given the same test, rather than being randomly assigned different modules from a larger question set designed to measure different literacy levels with greater precision. Third, the tests were given in conjunction with an in-depth urban labor survey which provides a detailed work history of each respondent. In addition to budgetary limitations, these choices in design were made because of a specific desire to analyze the connections between literacy and labor force outcomes rather than solely to describe the skill level of the labor force and how it varies with background characteristics.

Table A1
Deng and Treiman's (1997) List of Socialist Class Categories

I. Good-Class Origins (*jieji chengfen haode*), also referred to as the "five red kinds"
   A. Inherit Politically Red Background – families headed by pre-1949 party members, plus orphans of men who died during the revolution.
      1. Revolutionary cadres.
      2. Revolutionary army men.
      3. Revolutionary martyrs.
   B. Working Class.
      1. Pre-1949 industrial workers and their families.
      2. Former poor and lower-middle peasant.

II. Middle-Class Origins (*yiban chengfen*).
   A. Non-Intelligentsia Middle Class.
      1. Families of pre-1949 peddlers and store clerks, etc.
      2. Former middle-peasant families.
   B. Intelligentsia Middle Class. Families of pre-1949:
      1. Clerks.
      2. Teachers.
      3. Professionals.

III. Bad-Class Origins (*jieji chengfen buhaode*).
   A. Families of former capitalists.
   B. Families of "rightists" (those who were outspoken critics of Mao or the Party during the Hundred Flowers campaign of 1957).
   C. Pre-Liberation Rich Peasants.
   D. Families of "Bad Elements" (Criminal Offenders).
   E. Pre-1949 Landlord Families.
   F. Families of Counter-Revolutionaries.