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The Big Expansion of Rural Secondary Schooling during the Cultural Revolution and The Returns to Education in Rural China

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Abstract

During the Cultural Revolution China embarked on a dramatic, albeit temporary, expansion of secondary education in rural areas that affected tens of millions of children who reached secondary school age in the late 1960s and 1970s. The conventional wisdom is that this expansion was politicized and low quality. Using instrumental variables estimation, we exploit variation in the expansion across localities and birth cohorts to estimate the impact of Cultural Revolution education on individual outcomes. Creative use of historical county-level information matched with rich household survey data from the mid-1990s allows analysis of multiple outcomes. We find a significant, positive effect of Cultural Revolution years of education on off-farm employment and wage earnings. The effect on household income is mixed and likely reflects the substitution of market purchases for own production.

JEL Classification: I21, I28, J24, J31, O15

Key words: Education expansion, secondary education, returns to schooling, rural China, Cultural Revolution

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1 Introduction

In the late 1960s during the Cultural Revolution, China embarked on an unprecedented expansion of rural secondary education. In the mid-1960s before the expansion, all of rural China had fewer than 10,000 rural secondary schools, and most rural children did not progress past primary school. By 1977 at the peak of the expansion, rural China had more than 180,000 rural secondary schools, and secondary school enrolments had grown from 3 million to 51 million (Hannum 1999; Department of Planning, Ministry of Education 1984).

Despite the extraordinary magnitude of the expansion and its importance to the bulk of China's population—at the time, 85 percent of China's population was rural—the Cultural Revolution rural education expansion has received little attention. One reason for the paucity of studies is lack of data, a result of the disruption to China's statistical system during the Cultural Revolution. Perhaps another reason is that the expansion was temporary. After Mao's death when China embarked on economic reforms, it abruptly abandoned the rural secondary education expansion policy. Many rural secondary schools closed, and the levels of school attainment in rural areas dropped markedly.

Nevertheless, the expansion of rural secondary schooling during the Cultural Revolution persisted long enough to affect tens of millions of children. Furthermore, the affected cohorts entered the labor force in the 1980s, a time of growth in farm productivity, the emergence of rural township and village enterprises, and rising rural incomes. These developments are generally associated with the major economic policy reforms that were implemented at that time. The role of education and, more specifically, the impact of higher levels of rural schooling obtained during the Cultural Revolution have not yet received much attention and are not well understood.

In this paper we investigate the effects of the Cultural Revolution rural education expansion on the educational attainment and the subsequent labor market outcomes of the affected cohorts. We overcome the data constraints that have limited empirical analysis of the impact of Cultural Revolution in rural China through the creative use of data from multiple sources. A major constraint has been the lack of data on individual income, employment and wage outcomes. We obtain these from the China Household Income Project (CHIP) 1995 rural household survey. The 1995 CHIP survey gathered rich, detailed information about rural households and individuals, and the sample spans the cohorts that were affected by the Cultural Revolution education expansion at a time when they were in their prime working years. We match the CHIP data with county-level data from China's 1964, 1990 and 2000 censuses. Through inventive use of the census data, we assemble our instrument and controls for relevant county-level characteristics.

Our analysis involves estimation of the returns to schooling. It is well known that empirical analysis of the returns to schooling is susceptible to endogeneity bias due to the presence of unobserved characteristics such as ability and other factors such as measurement bias. Researchers have adopted a variety of strategies to correct for such bias in order to identify the causal relationship between education and labor market outcomes. One strategy is to exploit a natural experiment associated with an exogenous shock or policy change, for example, a change in compulsory schooling laws or a public program to expand the supply of schools (e.g., Devereux and Hart 2010, Devereux and Fan 2011, Harmon and Walker 1995, Oreopoulos 2006, Walker and Zhu 2008).

We adopt such a strategy here. The Cultural Revolution period saw a policy-driven exogenous expansion in rural schooling. Using instrumental variables (IV) estimation, we utilize the variation in the Cultural Revolution education expansion across localities and time to identify the causal relationship between years of schooling and outcomes for individuals in the affected cohorts.

We estimate the returns to Cultural Revolution education for a set of interrelated outcomes: household income, participation in off-farm wage employment, and wage earnings. The latter two outcomes are of interest because during the early reform period rural off-farm employment was growing rapidly and provided opportunities for higher earnings than farming. Household income is of equal or greater interest, because until recently household farming was the main source of income and main employer in rural China.

Our study makes several contributions. First, it contributes to the broader literature on the impact of secondary education expansion in developing countries. China is but one of many developing countries that experienced a major expansion of secondary education during this time frame. In 1970 secondary school enrolment rates in most developing countries were below 30 percent. By 2010 the secondary enrolment rate in the Middle East and North Africa had risen to 74 percent, in East Asia and the Pacific to 79 percent, and in Latin American and the Caribbean to 89 percent. Even in Sub-Saharan Africa, where education levels remain relatively low, secondary enrolment rates rose from 13 percent in 1970 to 40 percent in 2010. Our findings of a significant impact in China are in line with the findings of studies for other developing countries (e.g., Duflo 2001).

Second, our analysis provides new estimates of the returns to education in rural China that control for endogeneity, and for a wider range of outcomes. Studies of the returns to education in rural China that control for endogeneity are exceedingly few. To our knowledge only three such studies exist (Chen et al. 2017, Fang et al. 2016, Zhang 2018).[1] These three studies provide estimates of the returns to education in off-farm

[1] Fang et al. (2016) uses the 1986 Compulsory Schooling Law as an instrument and that reports the returns to years of schooling in rural China in terms of off-farm wage earnings at 20 percent. Zhang (2018) uses the closure of high schools in the late 1970s and early 1980s as an instrument and finds, as we do, that education obtained during the Cultural Revolution significantly increased the probability of off-farm employment. Fang et al. (2016) does not cover cohorts affected by the Cultural Revolution education expansion. Zhang (2018) does, but examines only off-farm employment participation, not income or earnings. Its estimation sample covers 4 birth-year cohorts that were affected by the closure of rural high schools at the end of the Cultural Revolution. Our analysis covers those birth-year cohorts who were affected by the rural education expansion and would have completed high school prior to the closure of rural high schools. An interesting, related study of the Cultural Revolution by Chen et al. (2020) looks at the impact of sent-down youth on educational achievement and several other outcomes.

employment and wage earnings, but their estimates exclude other income sources.

Zhang (2018) is perhaps the most closely related to our study. Zhang focuses on the closure of high schools at the end of the Cultural Revolution. He uses data from the 1 percent subsample of the 1990 census. The sample size is large, but the census contains limited information on schooling (only level, not years of schooling) and limited information on outcomes (only employment participation, not income or earnings). In contrast, the CHIP 1995 survey dataset, although smaller, contains richer information. Consequently, we can estimate the returns in terms of household income and wage earnings. Also, we can estimate the returns to years of schooling rather than to level of school attainment or completion, which is important because of the potentially confounding effects of differences in school length across locations and time. As will be discussed, the Cultural Revolution saw a substantial shortening in the length of secondary schooling.

Third, our findings provide insights into the long-term impact of the Cultural Revolution rural education policies. We document the significant increase in secondary schooling for the affected rural cohorts. We find that, despite the many reports about the low quality of education during the Cultural Revolution, the affected cohorts nevertheless enjoyed substantial subsequent benefits in terms of both off-farm employment and wage earnings. The benefits in terms of household income are mixed and differ between our two household income variables. We conclude that households adapted to wage earnings in ways that affected in-kind components of income, for example, by substituting cash purchases of food for own production. In-kind income is measured more fully by one of our household income variables than the other. These findings provide the basis for a more informed assessment of the long-term effects of education policies during the Cultural Revolution and, more generally, contribute to our understanding of the impacts of education in rural areas.

We begin in the next section with an overview of relevant features of the rural education expansion during China's Cultural Revolution. In section three we introduce the dataset and estimation sample. Section four outlines our empirical strategy. Here we discuss and justify our choice of instrument. Section five presents empirical results without correction for endogeneity. In this section we report OLS estimates of education regressions, household income regressions, off-farm employment participation Probits, and off-farm wage earnings regressions. Section six presents results of the IV regressions for household income, off-farm employment, and off-farm wage earnings. In section seven we conclude with a discussion of implications from these findings.

2 Rural Education during the Cultural Revolution

The Cultural Revolution was launched in 1966 with Mao Zedong's May 7 Directive, which called for a revolution in education, sparked political campaigns in schools and universities, and initiated sweeping reforms of the education system. The education system was a major target of the Cultural Revolution because it was thought to perpetuate social inequalities through its hierarchical structure, selective examination system, and 'bourgeois' curriculum.

Much has been written about the ensuing disruption of the education in urban China, and several empirical studies have analyzed the Cultural Revolution's impact on the schooling and subsequent labor market outcomes of urban residents (Giles, Park and Wang 2008, Meng and Gregory 2002, 2007, Zhang, Liu and Wang 2007). Rural education during the Cultural Revolution has received considerably less attention, but some studies outline the main features of rural educational policy at this time.

Following the May 7 Directive, China embarked on an ambitious program to expand secondary education in rural areas. The goal of the expansion was to achieve universal education through junior high school and to increase rates of progression to high school in rural areas (Pepper 1990, 95). In the mid-1960s less than a quarter of rural primary school graduates progressed to junior high school, and less than 10 percent of junior high school graduates progressed to high school (Hannum 1999). Consequently, achieving these goals required substantial increases in the numbers of rural secondary students, schools, and teachers. This was accomplished through decentralization of the education system and mobilization of local resources. Some funding was provided by the central and local governments, but most costs were borne locally by collective farms (Pepper 1990, 76-77; Löfstedt 1980, 131; Wang 2014).

Along with the expansion came reforms in the structure and content of rural education. The length of schooling was shortened, with some local variation but in most places from twelve to nine or ten years: five years of primary, two or three of junior high, and two of high school (Hannum 1999, 199; Löfstedt 1980, 131; Pepper 1990, 95; Wang 2014; Zhang et al. 2016, 51). Separate academic and vocational streams at the secondary level were merged, the curriculum was revised so as to cover a combination of academic, political, and practical content, and students were required to participate in work as well as study (Pepper 1990, 94-5; Shirk 1979). With the objective of achieving universal junior high school education, exam-based progression from primary through junior high school, which had weeded out all but a small proportion of students, was abolished; tuition and fees were reduced or eliminated (Han 2001; Shirk 1979; Zhang et al. 2016, 56). School finance and management was overhauled and decentralized. Within schools, decision-making authority was transferred from a school principal to school revolutionary committees made up of local peasants, students, and teachers with "red" political credentials, under the supervision of the commune or production brigade's revolutionary committee (Han 2001, Wang 2014).

National statistics on rural enrolments, numbers of schools and progression rates reveal the magnitude of the secondary education expansion (Figures 1, 2 and 3). Data are missing for 1966-1970, during which years many rural secondary schools were closed, but the marked differential between 1965 and 1971 reveals that a massive push started sometime between these years. Rural secondary school enrolments rose from 3 million in 1965 to 22 million in 1971 and then continued to rise to a peak of 50 million in 1977. Similar dramatic increases are evident in the number of rural secondary schools and progression rates, which reached a peak in 1976-77 and then declined. For example, the progression rate from junior to senior high school rose from 8 percent in 1965 to 35 percent in 1971, and further to a high of 64 percent in 1976.

After 1976-77 the numbers of rural schools and students shrank, and progression rates fell (see figures; see also Zhang 2018). This reversal reflected policy changes following the death of Mao. China's post-Mao leaders criticized the rural secondary school expansion as ill-conceived and as sacrificing school quality (Yang 2006). The low quality of rural education during the Cultural Revolution has been attributed to a variety of factors, for example, the emphasis on political and vocational content rather than academic content in the curriculum and basing school progression on political criteria rather than academic examinations.

Also relevant was a shortage of qualified teachers. The rapid expansion of secondary rural education required quickly finding large numbers of new teachers. The teacher shortage was exacerbated by the fact that many experienced teachers were criticized for being counter-revolutionary and demoted. County sources note that junior high teachers were shifted to senior high, primary teachers to junior high, and new primary teachers were enlisted from the local population, e.g., local cadres, model peasants, local youth with junior high schooling, and sent-down youth from urban areas.[2]

The shift back in education policy from emphasis on quantity to quality resulted in a substantial scaling back of rural secondary schooling (Pepper 1990, p. 96-7). In the span of only four years (1977-81), the number of rural secondary schools and the rates of rural school progression dropped substantially (Figures 2 and 3). The decline in rural secondary schooling in the late 1970s and early 1980s also reflected the consequences of decollectivization, which to a large extent dismantled the collective farm system. Collective farms had provided the institutional and financial framework supporting rural schools. Rural schools now began to charge tuition and fees, so that the costs of schooling borne by households increased. In addition, the spread of the household responsibility system and return to household farming increased the opportunity costs of keeping children in school, thus reducing the demand for schooling.

Although the expansion of rural secondary schooling during the Cultural Revolution was temporary, and although it was undoubtedly accompanied by a deterioration in the quality of rural education, it led to a broad-based increase in secondary school attainment. This can be seen in Figure 4, which shows census data for the proportion of rural individuals by birth year who attained junior high and high school. The increase is especially marked for high school. For cohorts born before 1952, which would have entered high school before the Cultural Revolution, high school attainment is below 5 percent. High school attainment begins to rise starting with the 1952-53 cohorts and reaches a peak of 21 percent for the 1960 cohort. For later cohorts high school attainment falls markedly to about 10 percent. These later cohorts would have reached high school age in the late 1970s, when rural secondary schools were closing.

[2] See Sicular (2019), which summarizes information found in county gazetteers about the rural teacher shortages and local strategies used to address those shortages.

Figure 1: Secondary School Enrolments in China, 1952-1990

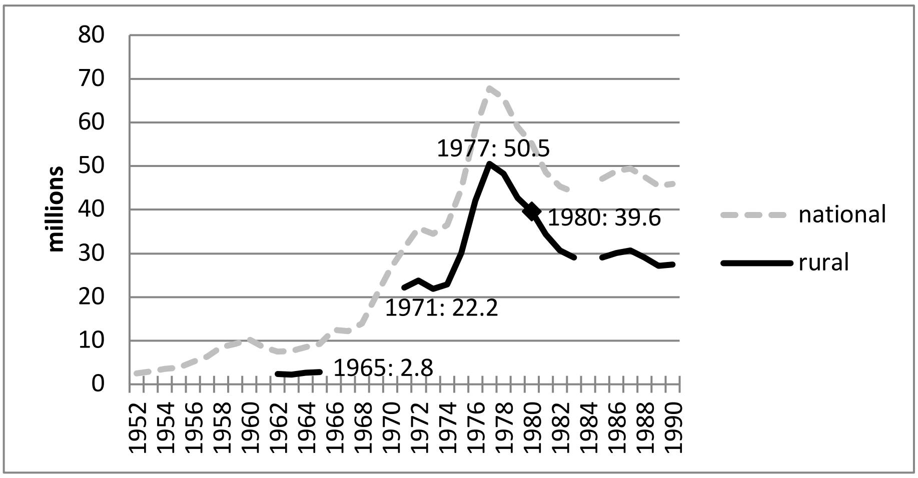


Figure 2: Number of Rural Secondary Schools, 1962-1990

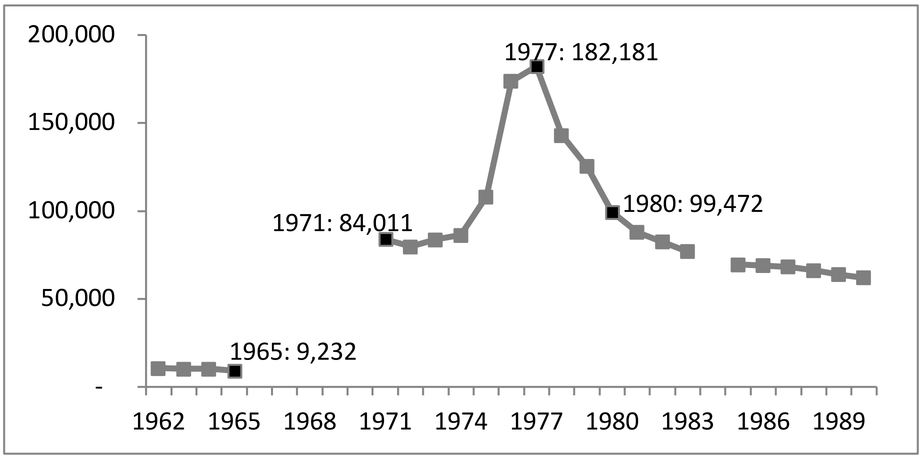
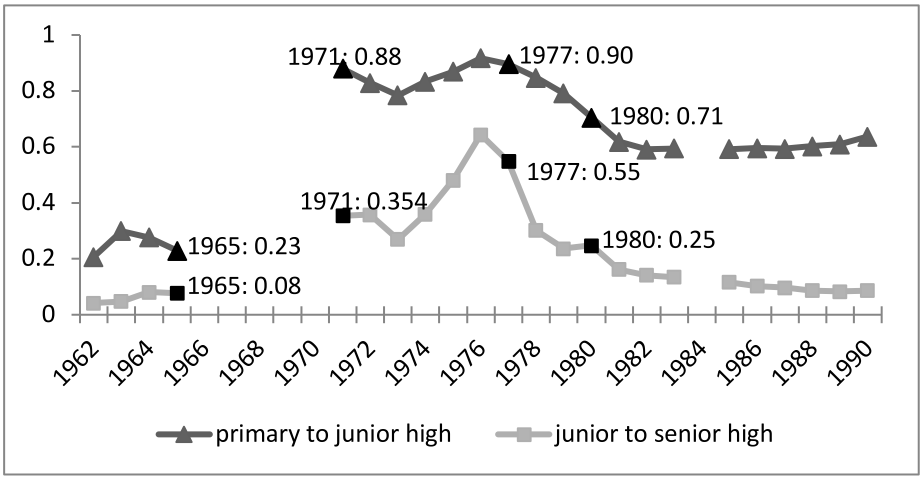


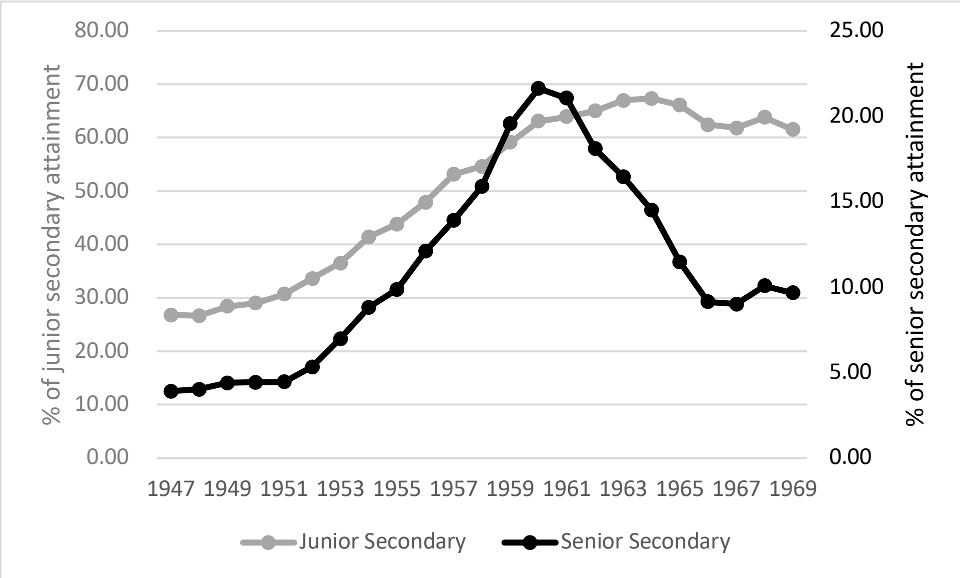
Figure 3: Rural School Progression Rates, 1962-1990



Notes to Figures 1-3: Statistics are for regular (*putong*) junior, senior, and combined junior-senior high schools. Progression rates are calculated as the number of school entrants divided by the number of graduates from the prior level of school.

Sources: Hannum (1999) and Department of Planning, Ministry of Education (1984).

Figure 4: Percent of the Rural Population that Attained Junior High and High School, by Birth-Year Cohort (Census 2000)



Notes to Figure 4: Percent attainment is the proportion that attained that level of schooling and higher, e.g., junior high attainment includes those who continued to high school.
Source: Authors' calculations using data from the 2000 Census.

3 The Data and Estimation Sample

For our analysis we employ individual and household data from the 1995 round of the CHIP rural household survey matched with information on county characteristics from other sources. The 1995 CHIP rural sample contains individuals who belong to the cohorts affected by the Cultural Revolution school expansion at a time when they were in their prime working-age years. The dataset contains rich information on individual characteristics including education, wage earnings, work participation, gender, age, and ethnicity, as well as information about relevant household characteristics such as household income, demographics, and land endowments.[3]

For our analysis we restrict the sample to males who were old enough to have entered and completed high school during the rural secondary school expansion period. The rural senior secondary education expansion began after 1968 (Han 2001, Sicular 2019) and was reversed starting in about 1977. We therefore restrict the sample to individuals born in the seven years 1953 through 1959.[4] We also restrict the sample to

[3] The provinces are Beijing, Hebei, Shanxi, Liaoning, Jilin, Jiangsu, Zhejiang, Anhui, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Sichuan, Chongqing (which in 1995 was still part of Sichuan province), Guizhou, Yunnan, Shaanxi, and Gansu. The full CHIP rural sample covers 8,000 households located in 112 counties of 19 provinces that span eastern, central, and western China. For more background on the 1995 CHIP survey, including discussion of sample selection and income definition, see Khan and Riskin (1998).

[4] Individuals born during these years would have entered high school during the expansion and would

those counties for which we are able to obtain matched county-level information. The resulting estimation sample contains 1,332 individuals in 85 counties, which span all 19 CHIP sample provinces.

We limit our estimation sample to males because two of the main variables of interest are off-farm employment participation and off-farm wage earnings. In 1995 very few rural women engaged in off-farm wage employment. In the 1995 CHIP rural sample less than 10 percent of women in the relevant birth-year cohorts reported off-farm wage earnings. We considered including women in our analysis of the returns to education for total household income, but the education of husbands and wives within the same household is highly correlated and nearly all individuals in the sample are married.

One potential weakness of the CHIP rural survey sample is that it does not include individuals who grew up in villages and later migrated permanently to the city or changed their place of household registration.[5] In the mid-1990s, however, such migration was still rare. China's household registration or 'hukou' system remained highly restrictive and prevented almost all permanent rural-urban migration. One of the few routes out of the countryside was through university, as university graduates could obtain urban residence permits. Exceedingly few rural students, however, gained entrance to university. Census data from 1990 provides evidence of the low levels of migration and high barriers to university: in 1990 only 2 percent of rural individuals had ever migrated, and less than 2 percent of all individuals born in the 1950s and 1960s—rural and urban—had any university education (Meng and Gregory 2002, Zhang 2018).[6]

We match the CHIP survey data with data on county-level variables from other sources. The county-level data include our instrument and other variables that we use to control for the potential endogeneity of the local rollout of the education expansion. The county-level variables come mostly from China's 1964, 1990 and 2000 censuses.

Ideally, the county-level control variables should influence but not be influenced by the education expansion. County-level data from before the Cultural Revolution is therefore ideal, but unfortunately such data are extremely limited. We were, however, able to locate some county-level information from the 1964 census records: the share

have been able to benefit fully from the expansion, as they would have been able to graduate before schools began to close in 1977. Before and during the Cultural Revolution, children started primary school at age 7. Before the Cultural Revolution in most rural areas primary school lasted 6 years and junior high 3 years, so rural children entered high school at age 16. Individuals born in 1953 would thus have entered high school at the start of the expansion . During the Cultural Revolution primary school was shortened to 5 years, junior high to 2-3 years, and high school to 2 years, which implies graduation from high school at age 17. Individuals born in 1959 would have reached age 17 in 1976 and thus would have been able to benefit fully from the expansion before secondary schools began to close in 1977.

[5] The CHIP 1995 survey does include household members who were engaged in short-term migration or who maintained a strong economic connection with their households of origin.

[6] Most of those who attended university were urban, so that the share of rural individuals in these cohorts who attended university was well below 2 percent.

of the non-agricultural population and the population sex ratio. We use these as controls for economic and social conditions within the county on the eve of the Cultural Revolution.[7]

We additional county-level control variables through the creative use of data from later censuses. In China, educational attainment and economic outcomes have differed between the ethnic minority and Han majority populations. County-level information on ethnicity is not available from the 1964 census, but published data from the 1990 census includes the population share of rural ethnic minorities by county. Due to the strict barriers to migration during the period of interest, the 1990 minority population share will be highly correlated with that in the mid-1960s.

County-level data on women's fertility are not available from the 1964 census, but we use data from the 1990 census to construct a measure of county fertility in late 1960s. The 1990 census provides county-level data on the average number of children born to women aged 60-64 years. Women aged 60-64 in 1990 would have largely completed their childbearing years by the late 1960s, when they would have been in their late thirties or early forties. We therefore use this variable as a measure of county average fertility prior to the rural secondary education expansion.

County-level census data disaggregated by birth year are only available starting with the 2000 census. We can nevertheless use these data to provide some cohort-specific control variables. First, we use the 2000 census data on the male population by birth year to control for the county supply of male students and labor in each birth-year cohort, which may have affected school attainment, income, employment and earnings.

Second, we use the 2000 census data to construct an indicator of the local severity of the Great Leap Forward famine. The Great Leap Forward famine, which took place from 1958 through 1961, is thought to have had long-term, negative effects on outcomes for children born during those years. Following Chen and Yang (2015), for each county we construct a variable that measures the cohort loss for individuals born in each of the famine years (1958-1961). For each of the famine years we predict the counter-factual cohort size based on a linear time trend between the cohort sizes for the pre-famine birth years 1952-1954 and the post-famine birth years 1963-1965. The cohort loss variable is equal to 1 minus the ratio of the actual to the predicted cohort size. This cohort loss variable applies to the two last birth years in our estimation sample, 1958 and 1959. For the other birth years in our estimation sample (1953-1957), we set the cohort loss equal to zero.

The 2000 census county data by birth year also provide our instrument, which is the share of the birth-year cohort in the county that attained high school.[8] We discuss the instrument more fully in section 4.

Finally, we include two geographic indicator variables. One is a dummy variable indicting whether the individual lives in a mountainous location (self-reported in the

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[7] In the 1964 census, the share of the non-agricultural population is defined as the share of the population that held a non-agricultural household registration or 'hukou'.

[8] Note that the census data on level of education indicate the highest level of schooling attained, while the CHIP data on level of education indicate the highest level of schooling completed.

CHIP survey). The other is a dummy variable indicating whether the province was a designated 'Third Front' region. The Third Front program was a major a major investment program in inland provinces that was launched in 1965 and continued well into the 1970s. The Third Front channeled large amounts of investment for the construction of factories and transportation into remote, underdeveloped provinces and counties (see Naughton 1988).

Table 1 shows descriptive statistics for the estimation sample. The average age is 39 years, and the average length of education is 7 years. Only 21 percent of the sample completed high school. Almost all individuals in the sample were married; average household size was 4.45, with 40 percent of household members being children and 4 percent seniors. Contracted land area, which was allocated to households by villages and can be considered an endowed asset, varied substantially in per capita terms. 18 percent of the sample participated in off-farm wage employment.

County characteristics were diverse. On average, the share of county birth-year cohorts that attained high school was 12 percent, but ranged from less than 1 percent to 42 percent. The size of county birth-year cohorts ranged from 0.5 to 14 million, reflecting substantial differences in population size among counties. On average only 7.5 percent of the county populations were non-agricultural in 1964, with the non-agricultural population share ranging from 2 percent to nearly 50 percent.

/insert Table 1 around here/

The Cultural Revolution secondary education expansion is evident in the dataset. Average years of education in the estimation sample were 6.9 for those born in 1953 and 7.7 for those born in 1959. Similarly, the share of individuals who had completed high school increased from 17 percent for those born in 1953 to 30 percent for those born in 1959.[9]

4 Empirical Strategy

We employ IV to estimate and identify the causal relationship between education and labor market outcomes.

4.1 The Instrument

In principle our instrument should be correlated with schooling but uncorrelated with unexplained variation in the labor outcomes of interest. A common choice is a variable that captures supply-side changes in education associated with policy reforms,

[9] The levels of schooling in the estimation sample are higher than the national averages. This reflects that the estimation sample is restricted to males, while the national averages include both males and females. The level of schooling for males in the cohorts of interest here is higher than that for females. See, for example, Lavely et al. (1990).

for example, the change in the supply of schools or in the length of compulsory schooling (Patrinos and Psacharopolous 2020).

Unfortunately, information for the Cultural Revolution on the usual sorts of supply-side education variables is either unavailable or insufficient to support estimation.[10] We therefore propose an alternative instrument: the county-level share of individuals by birth-year cohort that attained high school. This variable is available from China's 2000 census for all the counties and birth years in our estimation sample.

Although this variable is not a standard supply-side instrument, we would argue that it reflects shifts in the supply of (and not the demand for) schooling because during the period of study in rural China access to high school education was rationed. In the presence of a binding ration constraint, there would be excess demand and increases in high school attainment would be the result of changes in supply.

Descriptive studies of rural education on the eve of the Cultural Revolution portray a situation on the ground that is consistent with rationing. A common theme in these studies is the limited number of high school places and the competitiveness of the high school entrance examinations (*zhongkao*) used to determine which students could progress into those spaces (Andreas 2004, Han 2001, Thøgersen 2002, chapter 8). These studies explain that the demand for high school was strong because university, which required a high school education, was one of the sole routes out of the village.

The demand for high school education remained strong during the Cultural Revolution education expansion. Although the supply of secondary education increased, demand was also increasing rapidly. One reason was demographic: children born during China's baby boom in the early and mid-1960s were at this time entering and progressing through the schools. Another reason was the lowering of barriers that had winnowed the numbers of students who progressed through the schools. The elimination of exams and other selection mechanisms through junior high resulted in a surge in the number of junior high school graduates, thus further expanding the number of students eligible for high school. Meanwhile, having a high school education still yielded benefits in the form of increased opportunities to escape from hard farm labor into jobs such as village accountant, teacher, or local factory worker (Zhang et al. 2016, 56).

High schools, although also expanding, were unable to keep up with demand for spaces (Andreas 2004). Progression to high school continued to be subject to selection, albeit based on different criteria than before (Andreas 2004; Yu 2013, 31).

Aggregate data on the number of rural secondary schools is consistent with the presence of rationing. On the eve of the Cultural Revolution, the number of high schools located in rural areas was exceedingly small. In 1965 for a rural population of 586 million, China had in total only 3,364 rural high schools. Of these, only 604 were located in villages; the rest were in county seats and towns. Most counties in fact contained only one high school, and the national average progression rate from primary

[10] We inspected county gazetteers for counties in the CHIP 1995 sample. Consistent information on supply-side variables such as the number of schools and teachers was not available for enough counties to carry out estimation.

school through high school is estimated at only 2% (Sicular 2019).[11] Census data on school attainment similarly shows that rural youth in the relevant cohorts had exceedingly limited access to high school: among rural residents who reached high-school age in 1965 (born in 1949), only 3 percent had attended high school.[12] Access to high school improved substantially during the Cultural Revolution but even at the peak of the expansion was still limited. Among individuals who reached high-school age in 1976-77 (born in 1962-63), 13 to 15 percent had attended high school.[13]

Although we do not have sufficient county-level data on the number of secondary schools to use it as an instrument, aggregate data show rapid growth during the Cultural Revolution (Figure 2). Growth in the number of secondary schools occurred concurrently with growth in secondary enrolments and progression (Figures 1 and 3). Available county-level data from county gazetteers on the numbers of schools shows similar patterns. As a check, we searched county gazetteers for counties in our sample. The gazetteers contained information for 30 of the sample counties sufficient to calculate the percentage increase in the number of high schools from pre-expansion (1965/66) to peak expansion (1977/1978). This provided a measure of the local increase in the supply of high school education.[14] In these 30 counties, the percentage increase in school supply is strongly correlated with the percentage increase in high school attainment between the pre-expansion birth-year cohort (birth year 1952) to the peak (birth year from 1960 to 1962, depending on the county).[15]

It is possible that rationing was binding in the early years of the expansion but by the peak excess demand for high schooling had been absorbed. This is one reason why our estimation sample stops at the 1959 birth year, which ensures that individuals in the sample entered high school when the expansion was still in full swing and attainment levels were still rising. Individuals born in 1959 who had no schooling delays or interruptions would have been old enough to progress to high school at age 14 or 15, or in 1973 or 1974, before the peak of the expansion.

Inspection of the instrument reveals that the timing of the expansion was fairly uniform across counties. High school attainment began to rise everywhere with the 1952 or 1953 birth-year cohort, and in most counties the reversal occurred no earlier than the 1960 birth year (Sicular 2019). Despite similarities in timing, differences among counties exist in the initial, pre-expansion level of high schooling (for birth year

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[11] These school numbers are for 'regular' (putong) high schools. In the mid-1960s China had also started a push to expand the number of vocational and specialized secondary schools. Available data, however, do not distinguish between junior and senior levels and between urban and rural schools (Andreas 2004). Anyway, the separate vocational/specialized school stream was discontinued after 1966.

[12] Authors' calculations using census data on school attainment by birth year. See Figure 4 and Sicular (2019).

[13] Authors' calculations using census data on school attainment by birth year. See Figure 4 and Sicular (2019).

[14] This is an imperfect measure. County gazetteers report that the secondary schooling expansion was accomplished not only by building new schools, but also by adding to or expanding existing schools.

[15] The correlation is 0.24, significant at the 1 percent level of confidence.

1952) and in the extent of the increase during the expansion (the change in attainment between the 1952 and in 1959 birth-year cohorts). This variation is found both between and within provinces. It is possible that variation in the initial level of education and in the magnitude of the expansion were endogenous to conditions within the counties. To minimize potential bias, we control for a range of county characteristics that reflect historical, initial conditions that may have influenced the path of secondary school expansion as measured by our instrument.

We evaluate our instrument by examining the first-stage regression and with standard diagnostic tests. The instrument is strongly correlated with schooling and satisfies the diagnostic tests.

4.2 The Empirical Model and Estimation

Our empirical model consists of four equations:

$$ED_i = \alpha_0 + \alpha_1 Z_i + X_i\alpha_2 + C_i\alpha_3 + R_i\alpha_4 + \varepsilon_i \qquad (1)$$

$$lnY_i = \beta_0 + \beta_1 ED_i + X_i\beta_2 + C_i\beta_3 + R_i\beta_4 + \mu_i \qquad (2a)$$

$$M_i = \gamma_0 + \gamma_1 ED_i + X_i\gamma_2 + C_i\gamma_3 + R_i\gamma_4 + \omega_i \qquad (2b)$$

$$lnW_i = \tau_0 + \tau_1 ED_i + X_i\tau_2 + C_i\tau_3 + R_i\tau_4 + \varphi_i \qquad (2c)$$

The first of these is the education equation. For each individual, education ED_i is a linear function of the instrument Z_i, a vector of characteristics X_i of the individual and his household, a vector of characteristics C_i of the individual's county of residence, a set of birth-year dummy variables R_i, and a residual ε_i. The birth-year dummy variables control for age and unobserved determinants related to year of birth.

Because the number of counties in our sample is large relative to the number of individuals, some counties contain few observations. For this reason, we forego county-level dummy variables and instead control for county-level characteristics that reflect local factors that would have influenced levels of education and labor market outcomes within counties. As discussed in Section 3, these county-level variables reflect initial conditions in the county prior to the rural secondary education expansion.

We estimate equation (1) for two measures of educational attainment: years of schooling and an indicator variable for high school completion.[16] Years of schooling is estimated using OLS; high school completion is estimated using Probit.

Equations (2a, 2b, 2c) are the labor market outcome equations. Equation (2a) is a Mincer-type equation in which the outcome variable lnY_i is the natural log of household income. The outcome variable in Equation (2b) is the indicator variable M_i for participation in off-farm wage employment. Equation (2c) is a Mincer-type equation

[16] To allow for the possibility of nonlinear returns to years of schooling, we also estimated specifications that included squared years of schooling. The coefficients on the squared terms were not significant.

in which the outcome variable lnW_i is the natural log of individual off-farm annual wage earnings. The independent variables in these three equations include education, a vector of individual and household characteristics, a vector of county characteristics, and the birth-year dummy variables. We estimate these equations using each of the two alternative education variables.

The estimates for household income and wage earnings provide different but complementary information. Household income includes net income from all household activities, including wage employment of individual household members as well as joint household production activities, including farming which in the 1990s was the main source of rural income. Limiting the analysis to wage earnings would exclude the major source of income for most households and so give an incomplete picture of the returns to education.

Household income, however, is not reported for individual household members and reflects the contributions of other family members. Controls for household characteristics to some extent captures these contributions. Furthermore, household formation and intra-household decisions are a function of an individual's education. For example, the choice of spouse, age of marriage, and post-marriage intra-household decisions regarding fertility and labor allocation are functions of the individual's education. This is reflected in the positive correlation between the education levels of husbands and wives in our estimation sample as well as Chinese census data (see Nie and Xing 2019).[17]

The CHIP dataset contains two household income variables. One is household income as defined by the National Bureau of Statistics (NBS income). The NBS income variable was supplied by the NBS to CHIP, and it follows the official NBS income definition of household income. Details of the NBS 1995 income definition are not published, but it is known to include labor remuneration, net household income from farming and non-farm activities, income from assets, and transfer income net of taxes and fees. The other variable is based on a broader definition of household income defined by the CHIP research team (CHIP income). It is calculated using information collected in the CHIP survey and more fully encompasses components of income that were inadequately captured by the official NBS income variable.

For rural households, the main differences between CHIP income and NBS income are that CHIP income covers more fully in-kind types of income and the value of home-produced goods that are retained for own consumption.[18] CHIP income is about 41 percent larger than NBS income (Table 1).

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[17] Note that our estimation sample contains only one person per household, i.e., the sample does not include multiple individuals from the same household. This is the result of the sample being restricted to males born in the years 1953-1959 and no households in the sample contain two males born in these birth years.

[18] For a fuller discussion of the CHIP and NBS income definitions, see See Khan et al. (1993) and Khan and Riskin (1998). Note that, unlike most research using the CHIP income data, we do not include the imputed rental value of owner-occupied housing in our CHIP income variable. This is because we confine our analysis to the rural survey sample, and in 1995 a housing market did not exist in rural China.

We estimate equations 2a, 2b and 2c first using OLS and then IV and 2SLS. For OLS we report estimates using both years of education and high school completion for the education variable. For IV we only report estimates using only years of education, because a nonlinear first stage Probit regression violates the estimation requirements for IV.[19]

In the 1990s many rural adults did not participate in off-farm work, which raises the possibility of selection bias. Therefore, for the wage equations (2c) we present estimates that are corrected for selection into off-farm wage employment. The exclusion restrictions for the correction are household size, demographic composition, and land endowment. These variables were likely to affect selection into off-farm wage employment but not the wage earnings of those with off-farm wage employment.

In all regressions standard errors are adjusted for two-way clustering by county and birth year. The returns to education are likely to be heterogeneous among individuals. Our estimates of the returns to education measure the Local Average Treatment Effect (LATE), that is, the average returns for individuals whose length of schooling changed as the result of the education expansion. In magnitude of the low level of schooling prior to the expansion and the magnitude of the expansion, the size of this group was probably substantial.

5 Empirical Results, OLS Regressions

Table 2 reports OLS estimates for the education regressions. Column 1 gives the results for years of schooling and Column 2 for high school completion. In both specifications the estimated coefficient on the instrument, the percent of the individual's birth-year cohort in the county with high school attainment, is highly significant. Coefficients on some other control variables are also significant and of the expected signs.

/insert Table 2 around here/

Table 3 reports OLS estimates for the household income regressions. In columns 1 and 2 the education variable is years of education; in columns 3 and 4 it is the dummy variable for high school completion. The table shows results for both the NBS and CHIP definitions of household income. In all specifications the coefficients on education are positive but insignificant. As will be seen, education becomes significant in some but not all of the IV household income regressions.

/insert Table 3 around here/

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[19] Nonlinear first-stage regressions like Probits are 'forbidden' in IV estimation because they violate the requirement that in the second stage the residuals be uncorrelated with the fitted variables and covariates. See Angrist and Pischke (2009).

Table 4 shows the results for the off-farm wage employment Probit regressions. Column 1 gives the results for years of education and column 2 for high school completion. The estimated coefficients on both education variables are positive and significant. On the margin, an additional year of education is associated with a 2 percentage-point increase in the probability of off-farm employment. Completion of senior high is associated with a twelve percentage-point increase. 18 percent of the sample held off-farm employment (Table 1), so the magnitude of these estimates is relatively large.

/insert Table 4 around here/

Table 5 shows estimates for the OLS wage earnings regressions. The coefficient on years of schooling is positive and significant. An additional year of schooling is associated with an 11 percent increase in wage earnings. The coefficient on high school completion is also positive, but not significant.

/insert Table 5 around here/

A likely reason for the insignificant coefficient on high school completion in the OLS wage regression is that, due to changes in policies over time and local variation in policies, the length of schooling required to complete high school was not uniform. Among high school graduates in our estimation sample, the most common length of schooling is 9 years (41 percent of this group), followed by 12 years (21 percent). Quite a few high school graduates also report 10 and 11 years of schooling. Furthermore, among those who had completed 9 years of schooling, half reported being high school graduates, and half not.

Despite such variation, high school graduation is significant in the off-farm employment Probits. This reflects that, despite the lack of uniformity in length of schooling, high school graduates on average had more years of education than non-graduates. Consequently, high-school completion was an informative signal to employers. Indeed, a disproportionate share (33 percent) of observations with off-farm employment were high school graduates, as compared to 21 percent of the full sample (Table 1).

6 Empirical Results, IV Regressions

We begin with the estimates of the first stage regression, shown in Table 6. The coefficient on the instrument is positive and highly significant, and the regression has reasonable explanatory power. These features of the first stage regression are reflected in the IV diagnostic tests reported in tables to follow. The F-statistics all reject the null hypothesis that the instrument is weak at the 1 percent level of confidence. The endogeneity tests similarly reject the null hypothesis that the instrument is exogenous, and at the 1 percent level of confidence except in the IV household income regressions (p=0.0525).

/insert Table 6 around here/

Table 7 reports the results of the IV household income regressions. For CHIP income the coefficient on years of education remains insignificant as in the OLS estimate. For NBS income, however, it is significant and gives a return of 20 percent, larger than in the OLS regression.

/insert Table 7 around here/

The difference in the estimates for the two income definitions likely arises because CHIP income contains a fuller valuation of in-kind income than NBS income. As will be seen below, the IV estimates for off-farm employment and wages reveal that more years of education give a significantly higher probability of off-farm employment and also significantly higher wages in those jobs. Consequently, individuals with more years of education could contribute more cash income to their households. Households with more cash income could substitute market purchases for self-production of consumption goods and production inputs. For example, cash income would enable a household to purchase seed, feed, and fertilizer that it would otherwise have had to produce itself. Similarly, cash income would enable a household to substitute purchases of food for self-produced food.

Cash income and production outlays are measured well in both CHIP and NBS income. In-kind income, however, is measured more fully in CHIP income. Consequently, CHIP income will better reflect such adaptive behavior than NBS income. The net impact of having more wage earnings on household income can thus differ between the two income definitions, and it would be smaller for CHIP income than for NBS income.

The only other study that reports IV estimates of the returns to education in rural China for income that includes earnings from household agricultural and business activities is Fang et al. (2016). This study is for a different time period (late 1990s through early 2000s) and uses a different dataset with a different income variable than ours, but nevertheless its estimate of the return to years of education at 18 percent is close to our estimate of 20 percent for NBS income.

Table 8 shows estimates of the marginal effects for the off-farm employment IV Probit. An additional year of schooling increases the probability of having off-farm employment by 2 percent. The magnitude of the coefficient on years of schooling is the same as in the non-instrumented Probit regression. The significance and magnitude of other independent variables, however, change (see Table 3).

/insert Table 8 around here/

Table 9 shows results for the IV wage regressions without and with correction for selection into wage employment. The inverse Mills ratio is significant at the 5 percent level, suggesting that correction for selection (in column 2) is appropriate.

/insert Table 9 around here/

The results without and with correction are similar. The coefficients on years of schooling are highly significant, positive, and large. An extra year of schooling increased wage earnings by more than 60 percent. These estimates are substantially larger than the OLS estimates. Larger IV estimates for the returns to education are standard in the literature and can reflect measurement error or heterogeneity in the returns to education (the OLS estimate is an average treatment effect for the entire population, but the IV estimate is a local average treatment effect for the subgroup that changed its behavior due to the policy change). We also note that although our IV education coefficients are high, these estimates have large standard errors and are consistent with returns as low as 20 percent (with 95 percent confidence).

Other studies of the returns to education in rural China that use IV or other techniques to control for endogeneity, although not entirely comparable to our analysis, also show significant, positive returns to education that are higher than their OLS estimates. Zhang (2017) finds that high school completion increases the probability of off-farm employment by 17 percent. Chen et al. (2017), using 2004 data from rural Gansu province, finds that for wage earnings the returns to an additional year of education is about 7 percent. This estimate is smaller than ours, but the returns to education are likely lower in a relatively poor, undeveloped province like Gansu. Also, the estimates are local average treatment effects, and so the difference in estimates of the two studies will reflect differences in the subpopulations affected by the treatment.

7 Conclusions

Our findings confirm that the Cultural Revolution education expansion was associated with increased years of schooling and high school completion among affected individuals in rural China. Moreover, those individuals who increased their schooling as a result of the expansion benefited from an increased probability of participation in off-farm wage employment and higher wage earnings in such employment. In view of the magnitude of the expansion, the number of people who enjoyed these benefits was likely very large.

Despite the positive impact of schooling on wage employment and earnings, the returns in terms of total household income are mixed. For NBS income the returns are positive and significant. For CHIP income the returns are not significant. This difference likely reflects that CHIP income includes a fuller valuation of self-produced outputs and inputs, and it points to the effects of access to cash wage income on the substitution of market purchases for own production. Differences in measurement error between the two income variables, and correlation between the degree of measurement error and education, could also be relevant.

Our estimates of relatively large returns to education in off-farm employment and wage earnings seem at odds with the standard view that rural education during the Cultural Revolution was of poor quality. How could poor quality education yield such large, positive returns? One possible explanation is a credential effect. In the 1990s schooling—in particular high school completion—may have served as a sorting device used by local officials and employers to allocate scarce off-farm jobs and opportunities.

Another possibility is that the expansion of rural education during the Cultural Revolution in fact imparted useful knowledge and skills that raised productivity. Some studies support this interpretation (Andreas 2004, Bramall 2007, Wang 2014, Wang and Liang 2014). Wang (2014), for example, writes that in the early 1970s China promoted the development of small-scale rural industries and new agricultural 'green revolution' technologies to increase farm productivity. The rural industries and new farm technologies required workers with post-primary education, but such education was scarce. To illustrate, Wang (2014, 49) gives the example of a collective farm in Guangdong that had more than 20 pieces of farm machinery but not one person capable of repairing the machinery, so that the equipment had to be sent to the city for all repairs.

Several in-depth case studies based on fieldwork in rural counties report that Cultural Revolution-era secondary education prepared local youth to enter these new types of work (Andreas 2004, Han 2001). Han's (2001) study of a rural county in Shandong Province reports that before the Cultural Revolution the secondary school curriculum focused on preparation for college entrance examinations and had limited practical content. Reforms during the Cultural Revolution shifted the local curriculum towards practical knowledge and skills such as the operation and repair of machinery, the adoption and planting of new seed varieties, and basic veterinary skills for care of livestock. Han cites local evidence that demonstrates that these curriculum reforms, in combination with the substantial increase in secondary school attainment, dramatically changed the county's labor force composition and made possible growth in agricultural output and the development of rural township and village enterprises.

Such studies indicate that our positive estimates of the returns to Cultural Revolution education in rural areas could reflect net gains in labor productivity. If so, China's rural education expansion during the Cultural Revolution may have been instrumental to China's economic achievements during the early reform era, during which period substantial growth in rural household welfare as well as in rural sector output laid the foundation for China's economic take off.

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Table 1: Descriptive Statistics for the Estimation Sample

	Mean	Std. dev.	Min	Max
Education variables				
Years of schooling	7.15	2.49	0	12
High school completion (dummy)	.21	.4044	0	1
Outcome variables				
NBS household income (Yuan, by NBS definition)	6490	4785	1	54,861
CHIP household income (Yuan, by CHIP definition)	10921	8324	989	94691
Off-farm wage employment (dummy)	.18	.3830	0	1
Off-farm wages (Yuan)	1056	5619	0	93,600
Off-farm wages for subsample with off-farm wage employment (Yuan, n=236)	5916	12193	12	93,600
Individual characteristics				
Age (years)	39.35	1.96	36.00	42.00
Ethnic minority (dummy)	.06	.2443	0	1
Married (dummy)	.98	.1290	0	1
Characteristics of the individual's household				
% of children household members (<16 years)	38.9	16.80	0	66.67
% of working-age household members (16-60 years old)	56.9	16.46	22.22	100
% of senior household members (> 60 years)	4.2	9.75	0	66.67
Household size (persons)	4.45	1.09	1	10
Household land endowment (mu per person)	1.71	1.34	0.00	12.20
County characteristics				
% of county birth-year cohort that attained high school or higher	11.72	6.40	0.93	41.47
Size of county birth-year cohort (males, thousands)	5.10	2.83	0.54	14.48
% of county population that was non-agricultural in 1964	7.50	7.75	1.54	49.08
county population sex ratio in 1964 (male/female)	1.05	0.07	0.88	1.25
Great Leap Forward famine birth-year cohort loss in county	0.068	0.16	-0.065	0.74
% of county population that is ethnic minority in 1990	8.19	21.38	0.00	99.86
County fertility in late 1960s	5.20	0.78	3.86	8.56
County located in a Third Front province (dummy)	.57	.4948	0	1
Location is mountainous (dummy)	.23	.4200	0	1
Number of Observations	1,332			

Notes:

1. The estimation sample is restricted to males born in years 1953-1959 from the CHIP 1995 rural survey in those sample counties for which matching county-level data are available.
2. Calculated using weights (see text).
3. The CHIP 1995 survey dataset is the source of all variables except when noted otherwise.
4. The NBS income variable was supplied by the NBS to CHIP and follows the official NBS income definition. Details of the NBS 1995 income definition were not published, but it is known to include labor remuneration, net household income from farming and non-farm activities, income from assets,

and transfer income net of taxes and fees. Following Khan and Riskin (1998), the CHIP income variable is calculated using information collected from the CHIP 1995 survey respondents for these same income components plus a few additional components. The main differences between the CHIP and NBS income variables are: (a) CHIP income includes a few additional components of labor compensation, including in-kind compensation and compensation to village cadres, and (b) CHIP net income from household production differs somewhat from that in NBS income, e.g., it includes a fuller valuation of farm items produced for own consumption and there are some accounting differences in the reported costs of inputs. Unlike most other CHIP studies, we do not include the imputed rental value of owner-occupied housing in CHIP income. This is because in 1995 no housing market existed in rural China. See Khan and Riskin (1998) for fuller discussion about the CHIP (or 'CASS') income definition versus NBS income definition.

5. We classify an individual as having off-farm wage employment if he reports positive off-farm earnings from a wage job. The off-farm wage and off-farm employment variables do not include off-farm self-employment.
6. "% of county birth-year cohort that attained high school or higher" and "size of county birth-year cohort" are from the 2000 census. "% of county population that is ethnic minority in 1990" is from the 1990 census. "% of county population that was non-agricultural in 1964" and "county population sex ratio in 1964" are from the 1964 census. The availability of county-level information differs across China's population censuses. We have used the earliest census data available for each of these county-level variables.
7. "Great Leap Forward famine birth-year cohort loss in county" refers to the county- and cohort-specific population loss for cohorts born during the Great Leap Forward (GLF) famine years (1958-61). Following Chen and Yang (2015), for each county we compare the actual cohort sizes with counter-factual cohort sizes. The latter are predicted by estimating a linear time trend between the average cohort sizes for the 1952-1954 birth years and the 1963-1965 birth years (using data from the 2000 census). For the cohorts in our estimation sample affected by the Great Leap famine (birth years 1958 and 1959), the cohort loss variable equals 1 minus the ratio between the actual and counter-factual cohort sizes. For all other birth years in our estimation sample, the cohort loss variable is set to zero. The mean cohort loss shown in the table is the mean over all birth years in the estimation sample, including non-affected birth years. For the 1958 and 1959 birth years the average cohort loss was 35%.
8. "County fertility in late 1960s" is calculated using county-level data from the 1990 census on the average number of children born to women aged 60-64 years at the time of the census. Women aged 60-64 in 1990 would have been 38-42 years old in 1968 and so would have by that time largely completed their childbearing. This variable therefore is a measure of county-specific fertility behavior on the eve of the rural secondary education expansion.
9. "County located in Third Front province" refers to counties in those central and western provinces that were part of the Third Front inland investment program, which took place from the mid-1960s through the 1970s. They include Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Henan, Hubei, Hunan, and Shanxi.
10. "Location is mountainous" indicates whether the household lived in a mountainous area, as self-reported in the CHIP 1995 survey.

Table 2: Education Regressions

	Years of schooling (OLS)	High school completion (Probit, marginal effects)
% county high school attainment	0.069***	0.012***
	(0.015)	(0.002)
Ethnic minority	-0.009**	-0.001*
	(0.004)	(0.001)
Size of county birth-year cohort	-0.009	-0.004
	(0.029)	(0.004)
% county non-ag population in 1964	-0.005	-0.002
	(0.013)	(0.001)
County sex ratio in 1964	0.255	0.022
	(0.996)	(0.152)
GLF cohort loss in county	-0.556	0.034
	(1.007)	(0.163)
% county ethnic minority in 1990	0.005	-0.000
	(0.006)	(0.001)
County fertility before expansion	-0.241**	-0.001
	(0.103)	(0.015)
Third Front province	-0.721***	-0.090***
	(0.144)	(0.023)
Mountainous	-0.003	0.001**
	(0.002)	(0.000)
Constant term	7.921***	
	(1.090)	
Birth-year fixed effects	Yes	Yes
Observations	1,332	1,332
Adjusted R^2, pseudo R^2	0.095	0.069

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The standard errors are adjusted for county by birth year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 3: Household income regressions (OLS)

	(1) Ln CHIP income	(2) Ln NBS income	(3) Ln CHIP income	(4) Ln NBS income
Years of schooling	0.004	0.004		
	(0.006)	(0.008)		
High school completion			0.046	0.075
			(0.035)	(0.049)
Ethnic minority	0.003***	-0.001	-0.003***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Married	0.002**	0.002**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
% of children	-0.003***	-0.004***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
% of seniors	0.001	-0.000	0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Household size	0.151***	0.134***	0.152***	0.134***
	(0.015)	(0.021)	(0.015)	(0.021)
Household land endowment	0.015	-0.016	0.015	-0.019
	(0.012)	(0.023)	(0.012)	(0.022)
Size of county birth-year cohort	0.020***	0.012	0.021***	0.012
	(0.007)	(0.011)	(0.008)	(0.011)
% county non-ag in 1964	0.012***	0.020***	0.012***	0.020***
	(0.002)	(0.004)	(0.002)	(0.004)
County sex ratio in 1964	-1.195***	-0.299	-1.199***	-0.314
	(0.308)	(0.435)	(0.305)	(0.421)
GLF cohort loss in county	0.430	-0.302	0.367	-0.346
	(0.283)	(0.325)	(0.279)	(0.316)
Ethnic ratio in 1990	-0.003***	-0.001	0.003*	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Fertility in the late 1960s	0.000	0.008	-0.006	0.020
	(0.021)	(0.033)	(0.021)	(0.033)
Third Front province	-0.127***	0.073	-0.124***	0.075
	(0.037)	(0.064)	(0.038)	(0.063)
Mountainous	-0.002***	-0.003***	-0.002***	-0.003***
	(0.000)	(0.001)	(0.000)	(0.001)
Constant	9.546***	7.955***	9.537***	7.926***
	(0.344)	(0.510)	(0.341)	(0.491)
Birth-year fixed effects	Yes	Yes	Yes	Yes
Observations	1,332	1,332	1,332	1,332
Adjusted R^2	0.190	0.118	0.191	0.119

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. See the text and notes to Table 1 for discussion of the differences between CHIP and NBS income. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4: Off-farm wage employment, marginal effects (Probit)

	(1)	(2)
Years of schooling	0.020***	
	(0.005)	
High school completion		0.116***
		(0.025)
Ethnic minority	-0.001	-0.001
	(0.001)	(0.001)
Married	0.002*	0.002*
	(0.001)	(0.001)
% of children	0.001	0.001
	(0.001)	(0.001)
% of seniors	0.001	0.002
	(0.001)	(0.001)
Household size	-0.017	-0.018
	(0.013)	(0.013)
Household land endowment	-0.008	-0.009
	(0.010)	(0.010)
Size of county birth-year cohort	0.016***	0.016***
	(0.005)	(0.005)
% county non-ag in 1964	0.000	0.001
	(0.001)	(0.001)
County sex ratio in 1964	-0.127	-0.120
	(0.167)	(0.168)
GLF cohort loss in county	-0.248	-0.256
	(0.187)	(0.184)
Ethnic ratio in 1990	0.001	0.001
	(0.001)	(0.001)
Fertility in the late 1960s	0.007	-0.002
	(0.016)	(0.016)
Third Front province	-0.080***	-0.082***
	(0.025)	(0.025)
Mountainous	-0.000	-0.000
	(0.000)	(0.000)
Birth-year fixed effects	Yes	Yes
Observations	1,332	1,332
Pseudo R^2	0.0853	0.0892

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 5: Off-farm wage regressions (OLS)

	(1)	(2)
Years of schooling	0.113**	
	(0.047)	
High school completion		0.282
		(0.188)
Ethnic minority	-0.004	-0.004
	(0.009)	(0.010)
Married	-0.003	-0.005
	(0.008)	(0.008)
Size of county birth-year cohort	0.052	0.052
	(0.046)	(0.048)
% county non-ag in 1964	0.016*	0.018**
	(0.008)	(0.008)
County sex ratio in 1964	-0.547	-0.409
	(1.529)	(1.521)
GLF cohort loss in county	-0.348	-0.236
	(1.151)	(1.199)
Ethnic ratio in 1990	0.011	0.010
	(0.013)	(0.014)
Fertility in the late 1960s	-0.030	-0.059
	(0.154)	(0.162)
Third Front province	-0.536**	-0.554**
	(0.241)	(0.246)
Mountainous	-0.006*	-0.007*
	(0.003)	(0.004)
Constant	7.427***	8.485***
	(2.001)	(1.891)
Birth-year fixed effects	Yes	Yes
Observations	236	236
Adjusted R^2	0.100	0.078

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 6: First stage regression for IV

	Years of Schooling
% county high school attainment	0.073***
	(0.014)
Ethnic minority	-0.002
	(0.007)
Married	0.033***
	(0.007)
% of children	0.018***
	(0.005)
% of seniors	0.019**
	(0.010)
Household size	-0.098
	(0.082)
Household land endowment	-0.062
	(0.052)
Size of county birth-year cohort	-0.011
	(0.029)
% county non-ag in 1964	-0.003
	(0.013)
County sex ratio in 1964	0.860
	(0.960)
GLF cohort loss in county	-0.443
	(0.960)
Ethnic ratio in 1990	0.001
	(0.007)
Fertility in the late 1960s	-0.248**
	(0.106)
Third Front province	-0.748***
	(0.139)
Mountainous	-0.004**
	(0.002)
Constant	3.995***
	(1.260)
Birth-year fixed effects	Yes
Observations	1,332
Adjusted R^2	0.133

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 7: Household income regressions (IV)

	(1) Ln CHIP income	(2) Ln NBS income
Years of schooling	-0.075	0.200*
	(0.055)	(0.110)
Ethnic minority	-0.003**	0.005***
	(0.001)	(0.001)
Married	0.005**	-0.004
	(0.002)	(0.004)
% of children	-0.002	-0.007***
	(0.001)	(0.003)
% of seniors	0.003	-0.005
	(0.002)	(0.004)
Household size	0.145***	0.155***
	(0.017)	(0.027)
Household land endowment	0.012	-0.010
	(0.013)	(0.026)
Size of county birth-year cohort	0.018**	0.018
	(0.008)	(0.014)
% county non-ag in 1964	0.012***	0.020***
	(0.003)	(0.004)
County sex ratio in 1964	-1.132***	-0.488
	(0.315)	(0.475)
GLF cohort loss in county	0.314	-0.194
	(0.299)	(0.364)
Ethnic ratio in 1990	0.002	-0.006***
	(0.002)	(0.002)
Fertility in the late 1960s	-0.031	0.084
	(0.028)	(0.053)
Third Front province	-0.196***	0.244**
	(0.061)	(0.111)
Mountainous	-0.002***	-0.002*
	(0.000)	(0.001)
Constant	9.932***	6.917***
	(0.419)	(0.719)
Birth-year fixed effects	Yes	Yes
Observations	1,332	1,332
Diagnostic tests for IV		
Endogeneity test F(1,508)	3.778 (p=0.0525)	3.778 (p=0.0525)
F statistic for IV	25.49	25.49

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. See the text and notes to Table 1 for discussion of the differences between CHIP and NBS income definitions. The instrument is % of birth-year cohort in the county that attained senior high or higher. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 8: Off-farm employment, marginal effects (IV Probit)

Years of schooling	0.020***
	(0.000)
Ethnic minority	-0.001***
	(0.000)
Married	0.002***
	(0.000)
% of children	0.001***
	(0.000)
% of seniors	0.001***
	(0.000)
Household size	-0.017***
	(0.000)
Household land endowment	-0.008***
	(0.000)
Size of county birth-year cohort	0.016***
	(0.000)
% county non-ag in 1964	0.001***
	(0.000)
County sex ratio in 1964	-0.141***
	(0.001)
GLF cohort loss in county	-0.258***
	(0.001)
Ethnic ratio in 1990	0.000***
	(0.000)
Fertility in the late 1960s	-0.001***
	(0.000)
Third Front province	-0.085***
	(0.000)
Mountainous	-0.000***
	(0.000)
Birth-year fixed effects	Yes
Observations	1,332
Diagnostic test for IV	
Wald test of exogeneity	$\chi^2(1)$= 37,913
	(0.0000)

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 9: Off-farm wage regressions (IV)

	(1) Uncorrected	(2) Corrected
Years of schooling	0.629***	0.650***
	(0.229)	(0.219)
Ethnic minority	-0.003	0.004
	(0.009)	(0.010)
Married	0.000	-0.017*
	(0.007)	(0.010)
Size of county birth-year cohort	0.068	-0.135
	(0.051)	(0.097)
% county non-ag in 1964	0.008	-0.003
	(0.012)	(0.014)
County sex ratio in 1964	-2.121	-1.125
	(2.202)	(2.260)
GLF cohort loss in county	0.107	1.130
	(1.869)	(1.822)
Ethnic ratio in 1990	0.019	0.010
	(0.012)	(0.012)
Fertility in the late 1960s	0.050	0.129
	(0.193)	(0.193)
Third Front province	-0.450	0.531
	(0.301)	(0.546)
Mountainous	-0.006	-0.004
	(0.004)	(0.004)
Constant	4.107	15.227***
	(2.760)	(5.230)
Birth-year fixed effects	Yes	Yes
Inverse Mills Ratio		-15.926**
		(6.982)
Observations	236	236
Diagnostic tests for IV		
Test of endogeneity	p=0.0058	p=0.0034
F statistic for IV	10.95	10.83

Notes: Estimated using the CHIP 1995 rural survey data and matched county-level data, with weights. The instrument is % of birth-year cohort in county that attained senior high or higher. The standard errors are adjusted for county by birth-year clusters using the Liang-Zeger method. Adjusted standard errors are reported in parentheses. Note that in the corrected regression some of the coefficients on the birth-year fixed effects are significant. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.