Emerging from "The Darkness": The Effect of School Construction on Educational and Child Health in Nepal

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October, 2015
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Abstract

During the Rana regime in Nepal, rulers mostly prohibited educational practices. The fall of the Rana regime in 1951 introduced formal education in Nepal. The number of primary schools increased from 321 in 1951 to 3,163 in 1961. Using across-district variation in schools constructed and differences across cohorts affected by school construction, I evaluate the effect of school construction of 1950s on educational and infant health outcomes. I find that 1 new school increased ability to read and write by 1.8 and 1.9 percentage points among males and also reduced infant mortality. Using school construction of 1950s as instruments, I find that father's ability to read reduces infant mortality.

Keywords: literacy, parental education, child health

Introduction

Improving health standards of children in both developing and developed counties has been a matter of public policy concern. Studies till this day provide evidence "that years of formal schooling is the most important correlate of good health" (Grossman, 2008). Given the close association between education and health, it is reasonable to expect that school infrastructure may positively affect health of a society. This can be driven by two main channels. First, school infrastructure can increase education level. From a theoretical perspective, higher education may lead to better health outcomes through allocative and productive efficiency (Grossman, 1972). Second, a society with an adequate school infrastructure may attract better health facilities and services, which can further influence health. Since, health is a fundamental contributor of inputs for economic development—human capital—ignoring the potential effect of schooling infrastructure on health outcomes in a society can severely undermine the actual social benefits of schools.

A huge body of research indicates a positive association between education and health. However, relatively low volume of work, but a growing literature on its own, addresses the causal relationship between education and health. To surpass the issue of reverse causality and omitted third factor while evaluating the effect of education on health, researchers have relied on quasi-natural experiments. Currie and Moretti (2002) and Lleras-Muney (2005) finds that education positively affects health in the United States. Mazumder (2008) shows that Lleras-Muney's estimates are not robust after inclusion of state-specific time trends. Using changes in compulsory schooling laws in Britain, Clark and Royer (2013) show that reforms did not affect health outcomes. Focusing in developing countries, Breierova and Duflo (2004) (in Indonesia) and Osili and Long (2008) (in Nigeria) indicate that increasing female education reduces fertility. These results may be driven by schooling increasing opportunity costs of child bearing (Becker, 1981) or reducing child mortality. In support of the latter notion, using new junior high schools in Taiwan after 1968 as instruments for schooling, Chou et al. (2010) conclude that increase in schooling lead to a reduction in child mortality.

This study provide answers to two specific questions:

1. Can school infrastructure improve child health? I focus on child mortality—a matter of serious concern in developing nations.
2. Can basic parental literacy skills, such as ability to read and write, affect child mortality?

To answer questions stated above, I use a dramatic change in Nepal's educational system. Nepal has the youngest education system in the world, with formal education starting only in 1951. Before then, educational practices were strictly forbidden by the Rana regime—an oligarchy rule that persisted in the country for 104 years. During the Rana era, school opportunities were extremely restricted and severe penalties were inflicted on those attempting to promote education (Caddell, 2007). The fall of the Rana regime and establishment of a new-found democracy in 1951 introduced formal education practices in Nepal (UNESCO, 2000). The Ministry of Education was established in 1951, which planned on providing five years of primary education within 25 years (Wood 1959). Reports from the Ministry of Education in Nepal suggest that the number of primary schools increased from 321 in 1951 to 3163 in 1961—a tenfold increment (ARNEC, 1962).

As an identification strategy, I use the intuition that an individual's opportunity of obtaining education during 1950s depends on one's year of birth and district of birth where schools were constructed. Those who were of school going age throughout the 1950 decade should be more affected by the establishment of schools than older individuals. Also, effects should be higher in those districts where more schools were established.[1] After controlling for the district of birth and year of birth dummies, the interaction between age of an individual in 1960 and the total number of schools per district is used as the variable of interest. Similar identification strategy has been used in previous studies as well (Card and Kruger 1992; Duflo 2001; Chou et al. 2010).

The estimates suggest that 1 new school increased ability to read and write by 1.9 and 1.8 percentage points, respectively. Similarly, 1 new school is associated with a reduction in infant mortality by 0.3 percentage points. The IV estimates suggest that that 1 percentage point increase in ability to read is associated with a reduction in infant mortality by 0.13 percentage points.

In 1951, the adult literacy rate in Nepal was 5 % (Parajuli and Das, 2013). Introduction of formal education practices in 1951 followed by the rise in school infrastructure creates a quasi-natural experiment to evaluate the casual effect of basic level of education, such as father's ability to read and write, on child mortality. To the best of my knowledge, this is the first study to provide a causal evidence on effects of basic parental literacy on child mortality. The Preston curve states that additional increment in per capita income at lower levels of per capita income is associated with larger gains in life expectancy, compared to additional increases at higher levels of per capita income. Consistent with notion of the Preston curve, it is reasonable to speculate differential effects of levels of education on health. In fact, such a concept is prevalent in estimation of monetary returns to education in developing nations, with studies concluding that basic literacy and improvements in education at the lowest tails yield highest returns (Fasih, 2008).

I. Mechanisms—How Can Parental Education Affect Child Health?

Education can directly affect health. Educated individuals are more likely to be efficient producers of health with efficiency gains originating in two forms: 1) Productive efficiency; and

[1] This point is prominent in a country like Nepal where traveling from one place to another can be troublesome due to the undulating landscape and lack of road infrastructure.

2) Allocative efficiency (Grossman, 1972). Productive efficiency is obtained when an educated individual produces larger health output from given input. Whereas, allocative efficiency suggests that education may increase true level of information regarding the use of inputs in obtaining better health. For instance, Jensen and Lleras-Muney (2012) find that education decreased the probability of teen smoking and drinking in Dominican Republic. Similarly, it is reasonable to speculate that more educated individuals may realize the fact that prenatal care can improve infant health outcomes.[2]

A father's literacy can have positive effects on an infant's health through improvements of maternal health behaviors during pregnancy, which can be linked to poor infant health (Currie and Moretti, 2002). A literate father may be able to process valuable information regarding maternal and child health. For example, a father who is able to read is more likely to understand that drinking water from stagnant sources can be hazardous to a mother's and infant's health. Hence, he might choose other alternative such as chlorination or boiling water before drinking. Also, there is a possibility of health-information spillover from literate husbands to wives, which can in return affect child's health through mother's knowledge. The other direct pathway which may prominently affect child health is by educated individuals reducing their fertility. Focusing their studies in developing nations, Osili and Long (2004) (in Nigeria) and Breierova and Duflo (2004) (in Indonesia) show that education lowers fertility rate. Relating to Becker and Lewis (1973), as a result of lower fertility, a household can focus on "quality" of children rather than "quantity", which in return is likely to improve child health. In this study I provide causal evidence that literacy increases knowledge regarding contraceptive use among husbands and wives—a mechanism through which education may lower fertility.

[2] Aizer, Currie, and Moretti (2007) and Conway and Cutinova (2006) prenatal care can reduce instances of low-weight births.

Similarly, education a father can affect child health indirectly through increases in income. It has been well documented that education improves labor market outcomes such as employment opportunities and wages (Card 1999, Duflo, 2001). Specifically, Fasih's (2008) study emphasize that basic literacy and educational improvements at the lower tail yields the highest monetary returns. An increase in income can improve affordability of health-improving products (a stove to boil water, chorine) and access to health care (e.g. prenatal care and birth place of a child— homes versus health clinics).

II. An Introduction of Formal Education in Nepal

The Rana regime started in 1866 with the defeat of the Shah Kings and their era lasted till 1950. The Rana leaders thrived on maintaining absolute internal power and were concerned that providing education to the common public could make people conscious of their rights (Shakya, 1997). Schooling opportunities were extremely restricted during the Rana regime and severe penalties were inflicted on those attempting to flourish education. Wood (1959) writes, "Prior to 1951, education in Nepal was practically nonexistent". UNESCO estimates the literacy rate of 1 percent prior to 1950. An English journalist Landon, reminisces the situation in early 1950s by noting, "the first beginnings of education were looked upon with something of mistrust with which the medieval church of Rome heard of the work of scientist within her fold" (Landon, 1976).

The establishment of democracy in 1951 introduced formal educational practices in the country. The Ministry of Education of Nepal was established in 1951. Early in 1954, the Ministry of Education of Nepal appointed 46-man National Education Planning Commission, which formulated plans regarding education in Nepal. As a part of the plan the Ministry of Education worked on establishing "five years of universal primary education within 25 years" (Wood, 1959). The first Five Year Plan for Education was enacted in 1956 with the hopes of increasing literacy in Nepal (Caddell, 2007). In aspect of educational development, the 1950 decade has been termed as "emerging from darkness". Caplan (1970) writes that "a program to build schools in every corner of the country could be implemented in a relatively short time, which meant that results were highly visible". During this era, Nepal faced a spurt in school constructions. The Ministry of Education in Nepal reports that the number of primary schools increased from 321 to 3,163 from 1951 to 1960—approximately a tenfold increment in schools.

Figure 1 shows the spurt in school construction in 1950s. Here, the sample comprises of schools constructed in rural communities, which is the focus of this study. According to the figure, only 3 schools were constructed in 1930s, 65 in 1940s, and 264 in 1950s. Approximately 85 % of these schools are public schools, whereas, 15 % are privately owned. As The Ministry of Education was focused on improving literacy outcomes, the majority of these schools were primary education based. The construction of schools varied across the 5 development regions of the country (Eastern, Central, Western, Mid-Western, and Far-Western) as shown in Figure 2, with Mid-Western and Far-Western regions receiving low number of schools. It has to be noted that the intensity of school construction varied across districts within Nepal. Table 1 shows the number of schools available in 1960 in respective districts and developmental regions based on the sample used by this study.

III. Empirical Setting

A. Data

The data used in this study comes from the Nepal Living Standard Survey (NLSS), a detailed survey conducted by the collaborative effort of the Central Bureau of Statistics and the World Bank. The survey has a collection of comprehensive data on topics including but not restricted to education, health, employment, and migration. I use two waves of the NLSS surveys, including the survey years 1995 and 2003. I use both individual and community-level files to answer the research questions on hand.

Questions related to education are asked to individuals who are five years or older. Given an extremely low level of literacy prior to 1950, the main variables of interest of education are ability to read and ability to write. I assign a value "1" if a respondent is able to read, otherwise the value given is "0". Similarly, I create a binary variable to indicate whether an individual can write. To address the issue of individuals obtaining literacy through NGO literacy programs rather than schools, I create a binary variable to indicate whether an individual obtained education through NGO or other governmental programs.[3]

As a part of the survey, mothers are required to list all their children that she gave birth to, starting from the first to the last, regardless of whether or not the child is alive. Following this, a mother is asked for the date of birth of her child and day, month, and year for those children who died. Using this information, I create two forms for child mortality based on the timing of death: 1) Infant mortality—for those who died before the 1st birthday; and 2) Death before fifth year of birth. To investigate the gender differences in mortality, I divide variables by gender of the child.

A section of the community-level file, a part of the NLSS, provides a list of schools available in communities where interviews were conducted. This includes names of schools, years of operation of schools, and types of schools constructed (public versus private). I pool data from both waves of surveys, linking communities to appropriate districts where they belong. I calculate the district specific total number of schools available in 1960 by using the spurt in school construction in 1950s. Finally, the measure of school intensity is merged with the individual level file by the district of birth. It has be noted that the measure of school intensity does not vary

[3] Less than 1 percent of the sample reported having obtained education through NGO.

overtime. I control for other individual characteristics which are plausibly exogenous to school construction in 1950s. Such controls are ethnicity (categorical variables for Brahmins, Chhetris, and other ethnic groups), religious variables, and schooling status of parents.

While investigating the effect of parental education on health, it is crucial to pay attention to changes in health infrastructure. The estimated effects could be biased if changes in school infrastructure are correlated to changes in health infrastructure. Figure 2 shows the number of new health clinics established per year between 1950 and 2003. It has to be emphasized that changes in health infrastructure did not happen in a major scale till establishment of the National Health Policy (NHP) in 1991. A huge spike in new health clinics established after 1991 demonstrates this point. I provide a detailed discussion regarding health care in Nepal in Appendix I. In all specifications pertaining to child health, I control for the total number of health clinics available during the year and district of birth of a child. Information regarding the year of establishment of health clinics comes from community file of the NLSS.

B. Identification Strategy

An introduction of formal education in Nepal in 1951 followed by a rapid construction of schools in 1950s, which varied across the districts of the nation, creates a quasi-natural experiment to evaluate the effect of parental literacy on child health. Particularly, an individual's exposure to schools constructed in 1950s depends on the year birth, as well as the district of birth. Children in Nepal typically start attending primary school between ages 6 to 10. I consider individuals who were 10 to 20 year olds in 1960 (these individuals are 1 to 9 year olds in 1951) as those affected by the school construction of 1950s. The older individuals of ages 25 to 35 in 1960 (these individuals are 16 to 26 year olds in 1951) should not be affected by the school construction of 1950s. Moreover, the effect of school construction should be a decreasing function of one's age.

The second dimension of variation to aid the identification strategy comes from the intensity of school establishment across districts. The idea relies upon the logic that districts receiving higher number of schools should be affected more than districts receiving lower number of schools.[4] The methodology I follow is based on one developed by Duflo (2001).

The identification strategy used in this study can be explained by using Table 2. Table 2 shows means of ability to read and ability to write by cohorts and levels of intensity of school construction. The "high" intensity comprises of districts receiving higher number of schools in 1950s, whereas, the "low" intensity group includes districts receiving lower number of schools.[5] I compare basic literacy outcomes of individuals who were affected by the school construction of the 1950 decade (1 to 9 year olds in 1951) to those individuals who were already old enough to be affected by newly built schools (16 to 26 year olds in 1951), by high and low intensity groups.

In Table 2, it has to be noted that ability to read and write among older cohort is similar among districts that received higher number of schools and districts receiving lower number of schools. This suggest that the pretreatment outcomes of interest were not different between the districts receiving high number of schools and low number of schools. However, the percentage of younger cohort who were able to read and write increased dramatically in districts receiving higher number of schools (to 43 % and 39 % respectively) as compared to the same cohort born in districts receiving lower number of schools (31% and 28 % respectively). The difference in difference estimate in column (3) can be interpreted as a causal effect of school construction in 1950s on

[4] The identification requires a person to attend school in his/her district of birth; travelling across districts in search of better education will bias the effect of school construction. Focusing in rural communities of Nepal helps address this issue as traveling across districts in search of better education may bias the effect of school construction.

[5] High intensity districts are defined as districts having more than 3 schools available in 1960, which is the median of schools available in the particular year.

ability to read and write, under an assumption that in absence of school construction, there would be no systematic differences in terms of educational outcomes between the districts receiving low and high number of schools. Similar pretreatment means of ability to read and write among older cohort in districts with higher and lower schools provide suggestive evidence that the difference in difference estimates are not based on false assumptions. I conduct several tests to determine whether estimates obtained in this study are based on inappropriate assumption. I discuss this in more detail in Section III.

Estimates from Table 2 suggest that school construction of 1950s improved ability to read and write on average by 10 percentage points and 9.5 percentage points, respectively. On average 5 new schools were available per district in 1960, suggesting that 1 new school improved ability to read by 2 percentage points and ability to write by 1.9 percentage points. The basic empirical strategy shown in Table 2 can further be written in regression form as below:

$$E_{idl} = \alpha + \beta S_d * T_i + \mu X_{idl} + \tau_d + \rho_b + \omega_w + \varepsilon_{idl} \quad (1)$$

where, E_{idl} represent educational outcome of an individual i born in district d in year l, S_d is the number of schools in district d in1960, T_i is a dummy variable indicating whether an individual i falls in the affected age group (1-9 years in 1951), X_{idl} is a vector of individual specific characteristics, τ_d is district of birth dummies, $\rho_b$is the year of birth dummies, and ω_w is a survey year dummy. Equation (1) is estimated by using the OLS and standard errors are clustered at the district level. The coefficient of interest is β which reflects the average effect of one more school per district on educational outcomes.

IV. Results

A. Results on Education

Table 3 shows the basic results after estimating equation (1) for males and females. The coefficient of interest is on the interaction term between the treatment dummy and number of schools available in 1960. The results suggest that one school built increased ability to read and write among males by 1.9 and 1.8 percentage points, respectively. These estimates are statistically significant at the 1 percent level. But females were not affected by school construction of 1950s. This can be explained by the fact that societal norms in the 1950s did not value educating females. Hence, daughters were not sent to schools.

The identification relies on an assumption that there are no district specific effects unaccounted for in model specification which influences school construction as well as education. Relatively low number of schools were constructed in the Mid-Western and Far-Western development regions of the country. It is possible that other district level characteristics such as pre-treatment wealth levels, distance away from the central region, or degree of political connectedness with the national government governed the district-level establishment of schools. The use of district fixed effects in specifications will help address these issues to some extent by removing the influence of time invariant characteristics that may have affected school construction.

To examine whether the findings obtained in Table 3 are spurious, I conduct a falsification exercise by assigning individuals of ages 21 to 30 (in 1960) as a hypothetical treated cohort and those of 31 to 40 years (in 1960) as a control cohort. If education level increased in districts receiving higher number of schools before construction of schools, we should expect a positive and statistically significant coefficients. Table 4 shows that the effects from falsification exercise are small, close to zero, and never statistically significant at any conventional levels. Also, the coefficients for males are statistically different from coefficients shown in Table 3.

If school construction truly affected literacy outcomes among males, it is logical to expect that the effect of school construction should be a decreasing function of age. Following Duflo (2001), I estimate a model given below which is simply an extension of model presented in equation (1):

$$E_{idl} = \alpha + \sum_{j=10}^{31} \beta_j (S_d * T_{ij}) + \mu X_{idl} + \tau_d + \rho_b + \omega_w + \varepsilon_{idl} \qquad (2)$$

All variables in above equation are similar to those of equation (1), except T_{ij} is a dummy indicating whether individual i is of age l in 1960, which is interacted with the total schools available in district d in 1960. A comparison group comprises of those aged 32-35 in 1960. The coefficient of interest, β_j, indicates the effect of one new school in district d on a respective age group. We expect a decreasing pattern of β_j with age, as individuals who were 21 to 35 years should not be affected by school construction of 1950s.

The estimated coefficients are plotted in Figure 4 along with the 95 percent confidence interval lines when using ability to write as a dependent variable.[6] The plot demonstrates a decreasing pattern by age. The coefficients are positive between ages 10 to 20, whereas, the coefficients pertaining to 24 years and older fluctuate around zero. Figure 4 provides support to the findings in Table 3 (male group) by suggesting that school construction improved ability to read and write among males.

B. Reduced Form Results on Child Mortality

I use similar identification strategy to evaluate the effect of school construction on child mortality by estimating the equation presented below:

$$H_{idl} = \alpha + \beta S_d * T_i + \mu X_{idl} + \delta hp_{dl} + \tau_d + \rho_b + \omega_w + Trend_c + \eta + \varepsilon_{idl} \quad (3)$$

[6] The figure for ability to read is not presented but is similar to Figure 4 and is available upon request.

where the specification and the variables are similar to equation (1) with an exception that H_{idl} is child mortality outcome of father i, child born in district d, in year l; η is dummy for the year when the child was born; and hp_{dl} is number of health clinics available in district (d) during the year of birth (l). Standard errors are clustered at the district level.

Panel A of Table 5 presents reduced form findings of school construction in father's district of birth on infant mortality and mortality before five years of age. The table is further divided by gender. The coefficients on interaction term are negative across all columns, except column (5). This suggests that districts receiving more schools faced lower child mortality. Specifically, each new school is associated with a reduction in infant mortality by 0.26 percentage points. Columns (2) and (3) show that the results obtained in Column (1) is driven, to the most extent, by reduction in infant mortality among sons. The coefficient shown in column (2) is significant at the 5 percent level. But coefficient for daughters in Column (3) is statistically insignificant at the conventional levels. In Panel B of Table 5, I present the results from the control experiment (similar to Table 4). The coefficients on the interaction is small, statistically different from zero, and statistically different from the coefficients in Panel A.

V. Estimating the Effects of Literacy on Child Mortality

A. Two State Least Squares Estimates (2SLS)

An Ordinary Least Square estimate of schooling on health may present a biased estimate between schooling and health as other unobserved factors not accounted in the model can be related to education and also simultaneously affect health. For example, people who can read and write may be are more health conscious compared to individuals who are unable to read and write. This leads to a problem of omitted variable bias if level of health consciousness is not accounted in the model. In this case, the effect of schooling on health will be overstated. Moreover, better health can itself lead to higher education, creating an issue of reverse causality.

Under two assumptions, estimates of equation (1), shown in Table 3, validly represents the first stage of a two-stage least squares: 1) The health related outcomes and education outcomes would not have been systematically different between the districts receiving more schools and districts receiving less schools in absence of school construction in 1950s; and 2) The expansion in schooling infrastructure in 1950s affected health outcomes only through education. It is a serious concern if better schooling infrastructure attracted programs such as expansion in health infrastructure and clean drinking water supply provision. In this case changes in health related outcome could reflect both effects of education and health improvement programs. I discuss such possibilities below.

The estimates in Columns (1) and (2) of Table 3 provide evidence that school expansion in 1950s improved ability to read and write. Similarly, these are the results pertaining to the first stage of a 2SLS. The F-Statistics of 22.6 and 25.3 for ability to write and ability to read, respectively, are much larger than the F-Statistic of 10, which is used to access whether instruments are weak.

The predicted probability of being able to read is obtained from the first stage. As shown in equation (4) below, the predicted probability from the first stage is included in the second stage along with the other covariates. The excluded instrument in the mortality equation is the interaction term ($S_d * T_i$).

$$H_{idl} = \alpha + \beta \widehat{ability\ to}\ read + \mu X_{idl} + \delta hp_{dl} + \tau_d + \rho_b + \omega_w + Trend_c + \eta + \varepsilon_{idl} \quad (4)$$

Table 6 shows the results after estimating equation (4). Column (1) in Table 6 excludes year of child birth dummies, water source (in the survey year), and district specific linear time trends, Column (2) includes year of child birth dummies, Column (3) includes whether a household has a provision of piped water, and Column (4) additionally includes district specific linear time trends. I report the interaction between number of health clinics available in the year of child birth and the treatment group.

Columns (1) and (2) in Panel A show that 1 percentage point increase in ability to read is associated with a reduction in infant mortality by -0.13 (significant at the 10 percent level) and -0.14 (significant at the 5 percent level) percentage points, respectively. To put this in perspective, results in previous section suggests that school construction in 1950s increased ability to read by approximately 10 percentage points. Combining this result with the findings from Table 6 in Column 1, calculation suggest that 10 percentage points increase in ability to read is associated with a reduction in infant mortality by 1.3 percentage points. Performing calculation at the mean suggest that 2.7 percent increase in individuals who are able to read results to a reduction in infant mortality by 4.5 percent. This gives an elasticity of 1.67. Estimates from Panels B and C suggest that increase in ability to read results to a reduction in infant mortality among sons but not among daughters. Perhaps, societal preference of sons in favor of daughters may explain such findings.

The validity of instruments is based on a crucial assumption that school construction in 1950s had no direct impact on infant mortality except through increases in education. It is possible that more health clinics and other development projects were constructed in districts receiving more schools. In this case, school construction complements other infrastructure. Similarly, one can expect a case of substitution, where other development projects are constructed in districts receiving lower number of schools. All specifications in Table 6 includes an interaction term between treatment group and the number of health clinics available in district during the year of a child's birth. To a certain extent, this addresses the potential omitted variable bias problem which is likely to exist from not including a measure of health infrastructure in health specifications. Additionally, it has to be emphasized that health related development in Nepal did not happen in a major scale until the establishment of the National Health Policy (NHP) in 1991. This is evident from a spurt in new health clinics established after 1991, which is shown in Figure 3. By this time the youngest cohort of this study is of age 40.[7]

The other concern is provision of drinking water. Unfortunately, I cannot exactly identify whether a household has an access to drinking water (water supplied through pipes) during the year of a child's birth. However, provision of water supply is available in survey years (1995 and 2003). Controlling for these measures in Columns (3) and (4) in Table 6 does not change the IV estimate. But caution should be provided, as provision of water supply can be endogenous in the model. To further examine the development regarding drinking water, I plot the number of new projects aimed at improving drinking water supply by year at the community level in Figure 4. The figure shows that no initiative was shown to improve drinking water supply until 1992, which marks the year of establishment of the Water Resource Act in Nepal.

To examine whether the IV estimates are appropriate in magnitude, I conduct a back of the envelope calculation—1 new school increased ability to read by 1.9 percentage points and 1 new school is associated with a reduction in infant mortality by 0.3 percentage points. If school construction influenced infant health majorly through improvement in ability to read, 1 percentage point increase in ability to read should reduce infant mortality by about 0.16 percentage points. The IV estimates in Table 6, Panel A, fall close to this value.

Besides aiding with an estimation of a causal relationship between education and health related outcomes, the use of instrumental variable lessens the issue of classical measurement error in

[7] 93 percent of birth in the sample happened before 1991.

ability to read and ability to write. Random measurement error on educational outcomes may create a downward bias on OLS estimates. Although, measurement error is likely to be of a higher intensity when using years of education rather than ability to read as a dependent variable. It has to be noted that the IV estimates can have a different interpretation than OLS estimate due to heterogeneity returns to education (Card 1995). It is likely that marginal returns to schooling may be higher for those individuals who otherwise would have no schooling in an absence of school construction. Here, the interpretation is that of a Local Average Treatment Effect (LATE). The IV estimates reflect the effect of ability to read for men who would not have gone to school in absence of school construction in 1950s.

B. Is Sample Selection an Issue?

It is important to understand the role of sample selection while relying on estimates reported in this study. Life expectancy of an average Nepali in 2000 was 62 years. The oldest individual in the treatment group is 20 years in 1960, who are 55 years old in 1995 and 63 year olds in 2003. Similarly, the oldest person in the control group is 65 years in 1960 and 73 years in 2003. It is likely that the sample in control group suffers from selection problem if individuals of older ages are not able to enter the survey due to death by aging. This leads to a question of whether sample selection overestimates or underestimates the results presented until now. Unfortunately, selection issue of this type cannot be addressed by using method first suggested by Heckman and Hotz (1989).

If deaths are random, selection will not affect the biasedness of estimates. However, after a certain age, deaths are likely to be an increasing function of age. If life expectancy is affected by schooling, sample selection may induce a correlation between the variable of interest and error terms in all specifications. Lleras-Muney (2005) finds that an additional year of schooling lowers the probability of dying in next 10 years by 1.3 percentage points. If relatively more educated individuals are likely to fall in the control group due to less educated individuals dying faster, the effect of school construction on educational outcomes will be biased downwards. Similarly, if education truly affects choice of health, then individuals in control group may comprise of relatively healthy people (as some ages of control group exceeds the average life expectancy during the survey years). This will create a downward bias on reduced form estimates and the IV estimates of education on child mortality. In summary, if relatively healthy individuals fall in the control group and if these individuals are likely to have better education, sample selection will create a downward bias on the variable of interest.

VI. Conclusion and Discussion

Nepal experienced an introduction of formal education in 1951 which gave rise to schooling infrastructure in 1950s. I first examine the effects of school construction on ability to read, ability to write, and infant mortality. Using school construction as instruments, I estimate the effect of education at the lower tail, i.e. ability to read and write, on infant mortality. The majority of studies investigating the causal effect of education on health uses introduction of compulsory schooling laws as instruments. The contribution of this study is that it investigates the causal effect of parental education at the very lower tail on child health outcome.

I find that 1 new school increased ability to read and write by 1.9 and 1.8 percentage points, respectively. Overall, school establishment in 1950s increased ability to read and write about 10 percentage points. The reduced form specifications suggest that an increase in school infrastructure led to a reduction in infant mortality. Using spurt in school construction as instruments, I find that a 1 percentage point increase in ability to read is associated with 0.13 percentage point reduction in infant mortality. Several robustness exercises support causal interpretation of these estimates.

To access the magnitude, 10 percentage points increase in ability to read due to rise in school infrastructure in 1950s decreased infant mortality by 1.3 percentage points. The IV estimate represent the Local Average Treatment Effect.

Chou et al. 2010 finds that increases in schooling associated with 1968 education reform in Taiwan saved 1 infant life in 1,000 live births. Lleras-Muney's (2005) estimates suggest that 10 percent increase in education lowers mortality by 11 percent in the United States, resulting to an elasticity of -1.1. Clark and Royer (2013) find no significant effect of an increase in education due to an introduction of compulsory education law in Britain on own health-related outcomes. The estimates obtained in this study cannot be directly compared to estimates of existing studies due to differences in societal norms (e.g. patriarchal society), health insurance system, rate of infant mortality, access to health care, and huge differences in overall development of nations. But the results suggest that improvements in father's educational outcomes at the very lower tail can improve child's health in developing nations like Nepal.

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Figure 1

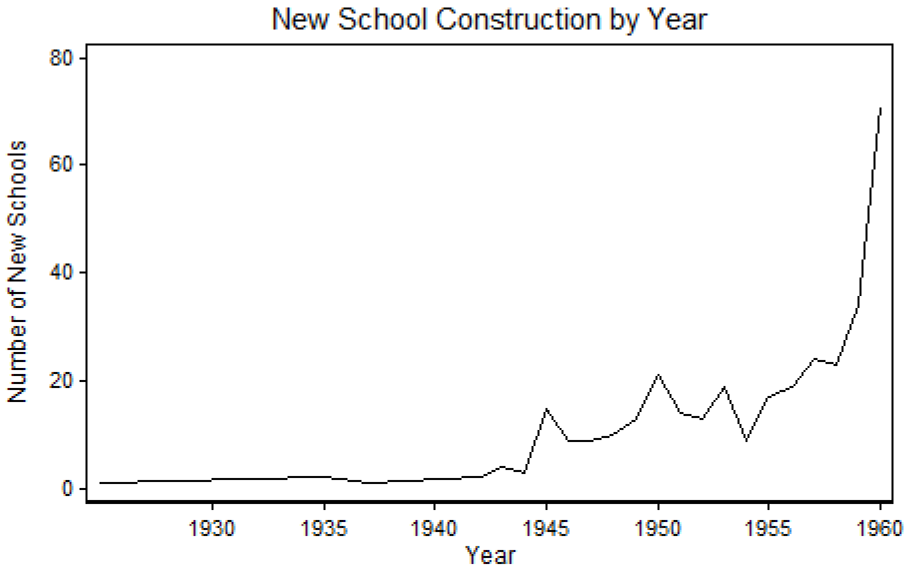
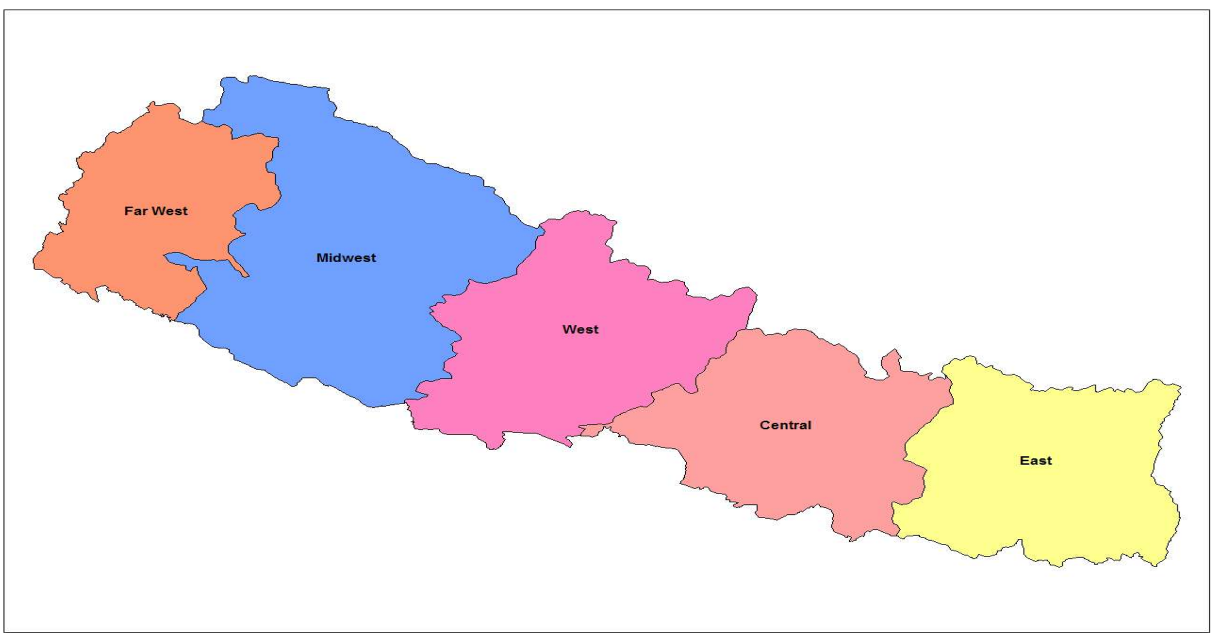
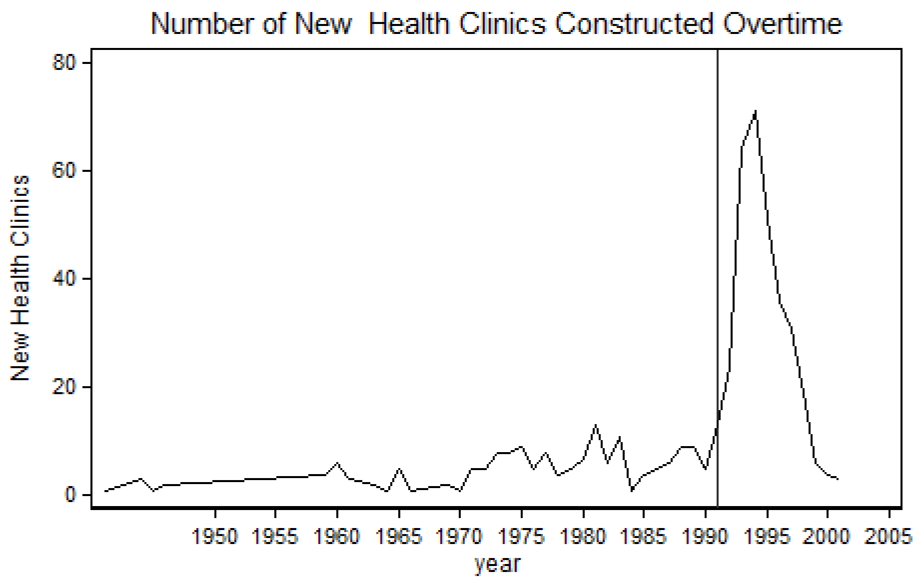


Figure 2



Note: Far-Western and Mid-Western regions received relatively less schools in 1950s (on about 2 schools per district).

Figure 3



Note: The National Health Policy was established in 1991.

Figure 4

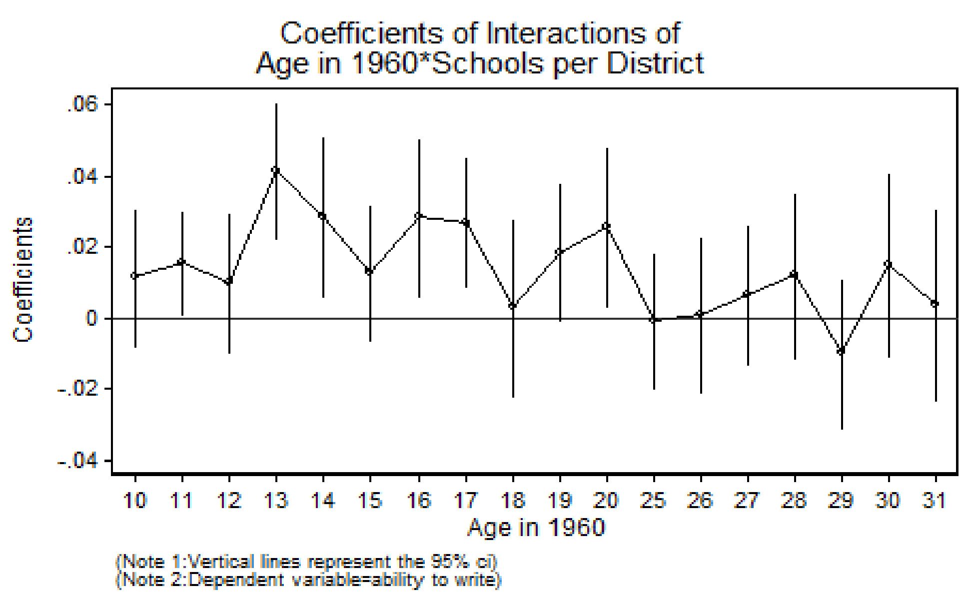
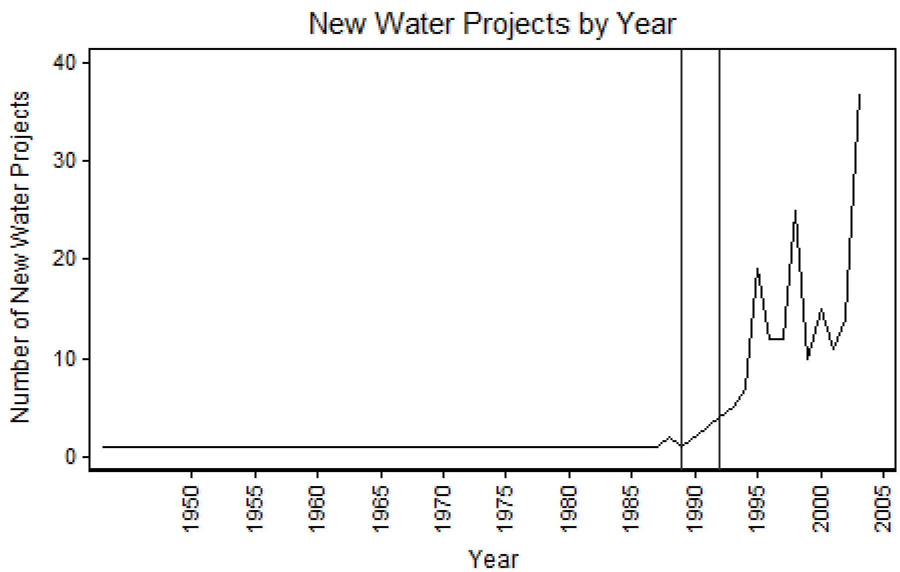


Figure 5



Note: Nepal Water Supply Corporation Act was established in 1989 and the Water Resource Act (WRA) took place in 1992. The WRA is considered as the main law governing water resource management.

Table 1. (Regions represent development regions of Nepal)

District	Number of Schools in 1960	Region	District	Number of Schools in 1960	Region	District	Number of Schools in 1960	Region
Taplejung	7	E	Bhaktapur	2	C	Rolpa	1	MW
Panchthar	10	E	Kathmandu	10	C	Kapilbastu	3	W
Ilam	17	E	Nuwakot	2	C	Rukum	1	MW
Jhapa	12	E	Kavrepalanchok	3	C	Salyan	2	MW
Morang	14	E	Dhading	5	C	Dang	9	MW
Sunsari	10	E	Makwanpur	1	C	Banke	3	MW
Dhankuta	3	E	Rautahat	5	C	Bardiya	2	MW
Terathum	7	E	Bara	8	C	Surkhet	1	MW
Sankhuwasabha	8	E	Parsa	3	C	Dailekh	2	MW
Bhojpur	11	E	Chitwan	0	C	Jajarkot	0	MW
Solukhumbu	1	E	Gorkha	8	W	Dolpa	0	MW
Okhaldhunga	1	E	Lamjung	2	W	Jumla	0	MW
Khotang	0	E	Tanahun	4	W	Kalikot	0	MW
Udayapur	2	E	Syangja	6	W	Mugu	1	MW
Saptari	7	E	Kaski	11	W	Humla	0	MW
Siraha	7	E	Manang	0	W	Bajura	3	FW
Dhanusha	2	C	Myagdi	3	W	Bajhang	5	FW
Mahottari	7	C	Parbat	3	W	Achham	1	FW
Sarlahi	13	C	Baglung	6	W	Doti	1	FW
Sindhuli	4	C	Gulmi	5	W	Kailali	1	FW
Ramechhap	1	C	Palpa	6	W	Kanchanpur	1	FW
Dolakha	4	C	Nawalparasi	3	W	Dandheldhura	1	Fw
Sindhupalchok	12	C	Rupandehi	15	W	Baitadi	3	FW
Lalitpur	15	C	Arghakhanchi	7	W	Darchula	3	FW
			Pyuthan	3	MW			

Table 2A. Summary Statistics

Variable	Mean	Std. Dev.
ability to write	0.172	0.378
ability to read	0.194	0.396
schools per district in 1960	5.699	4.271
dad literate	0.143	0.350
mom literate	0.026	0.158
Brahmins	0.190	0.392
Chettri	0.144	0.351
Other Caste	0.667	0.471
community population	952.992	967.634
learned to read through NGO	0.002	0.043
female	0.480	0.500
infant mortality	0.024	0.154
mortality before 5 years of age	0.092	0.288
health clinics available during year of birth	1.258	1.658
piped water available (in survey year)	0.122	0.327
toilet available (in survey year)	0.244	0.430

Note: N=3,183 for all variables except N=4,874 for infant mortality, mortality before 5 years of age, health clinics available during year of birth, piped water available, and toilet available.

Table 2B. Means and Standard Deviations for Ability to Read and Write

	Ability to Read			Ability to Write		
	Intensity of School Construction in Region of Birth			Intensity of School Construction in Region of Birth		
	High (1)	Low (2)	Difference in Difference (3)	High (4)	Low (5)	Difference in Difference (6)
Age 0 to 10 in 1960	0.426	0.311		0.389	0.282	
	(0.495)	(0.463)		(0.488)	(0.451)	
Age 15 to 25 in 1960	0.293	0.285		0.261	0.249	
	(0.456)	(0.452)		(0.440)	(0.433)	
Difference	0.133	0.026	0.107	0.128	0.033	0.095
	(0.032)	0.037	(0.041)	(0.316)	(0.036)	(0.041)

Note: High intensity districts are defined as districts having more than 3 schools available in 1960, which is the median of schools available in 1960.

Table 3. Effect of School Construction on Educational Outcomes

	Males		Females	
	Ability to Write	Ability to Read	Ability to Write	Ability to Read
	(1)	(2)	(3)	(4)
Treatment *number of schools per district	0.0180***	0.0189***	0.0008	0.0015
	(0.0046)	(0.0038)	(0.0018)	(0.0020)
Chettri	0.1101***	0.1200***	0.0206	0.0135
	(0.0373)	(0.0420)	(0.0157)	(0.0144)
Brahmins	0.1546***	0.1735***	0.0226	0.0353**
	(0.0408)	(0.0412)	(0.0145)	(0.0165)
Dad Literate	0.2503***	0.3339***	0.0866**	0.1233***
	(0.0568)	(0.0585)	(0.0354)	(0.0375)
N	1,654	1,654	1,529	1,529
R square	0.2500	0.2614	0.1252	0.1241
F Statistic	22.6781	25.3217	1.7018	2.2087

Note: All specifications include mother's literacy status, ward population, survey year indicator, year of birth fixed effects, and district of birth fixed effects. All regressions are weighted by household weights provided by the NLSS. Standard errors are presented in parenthesis and are clustered at the district level. * represent significant at the 10 %, ** at 5 %, and *** at 1 %.

Table 4. Effect of School Construction on Educational Outcomes (Falsification Test)

	Males		Females	
	Ability to Write	Ability to Read	Ability to Write	Ability to Read
	(1)	(2)	(3)	(4)
Treatment *number of schools per district	0.0046	0.0026	-0.0007	0.0006
	(0.0074)	(0.0064)	(0.0009)	(0.0013)
Chettri	0.0388	0.0397	0.0086	-0.0037
	(0.0520)	(0.0515)	(0.0161)	(0.0184)
Brahmins	0.1414**	0.1532**	0.0053	0.0237
	(0.0577)	(0.0652)	(0.0201)	(0.0244)
Dad Literate	0.2636***	0.4092***	0.0609	0.0778
	(0.0857)	(0.0834)	(0.0488)	(0.0516)
N	757	757	677	677
R square	0.2617	0.2821	0.1485	0.1422

Note: All specifications include mother's literacy status, ward population, survey year indicator, year of birth fixed effects, and district of birth fixed effects. All regressions are weighted by household weights provided by the NLSS. Standard errors are presented in parenthesis and are clustered at the district level. * represent significant at the 10 %, ** at 5 %, and *** at 1 %.

Table 5. Effect of School Construction on Child Health Outcome

	Infant Mortality (Before a Year)			Mortality Before 5 Years of Age		
	(1)	(2)	(3)	(4)	(5)	(6)
	all	sons	Daughters	all	sons	daughters
Treatment *number of schools per district	-0.0032**	-0.0046**	-0.0016	0.0001	0.0022	-0.0051
	(0.0014)	(0.0023)	(0.0016)	(0.0023)	(0.0029)	(0.0035)
Treatment *number of clinics per district	-0.0012	-0.0042	0.0030	0.0019	-0.0014	0.0079
(in year of child birth)	(0.0035)	(0.0040)	(0.0050)	(0.0057)	(0.0077)	(0.0079)
N	4,874	2,637	2,237	4,874	2,637	2,237
r2	0.0671	0.1173	0.0994	0.0630	0.1058	0.1094

Note: All specifications include ethnicity indicator (Brahmin, Chettri, others), mother's age, ward population, survey year indicator, year of birth fixed effects, year-of-birth-of-child dummies, and district of birth fixed effects. All regressions are weighted by household weights provided by the NLSS. Standard errors are presented in parenthesis and are clustered at the district level. * represent significant at the 10 %, ** at 5 %, and *** at 1 %.

Table 6. The Effect of ability to Read on Infant Mortality

Panel A (sons and daughters)	(1)	(2)	(3)	(4)
IV estimate	-0.0013*	-0.0014**	-0.0014**	-0.0017**
	(0.0007)	(0.0006)	(0.0007)	(0.0007)
Treatment * number of health posts (year of child birth)	-0.0067***	-0.0061**	-0.0062**	-0.0066**
	(0.0022)	(0.0029)	(0.0029)	(0.0031)
Year child birth dummy	No	Yes	Yes	Yes
Water source (in survey year)	No	No	Yes	Yes
District specific linear time trend	No	No	No	Yes
N	4,714	4,714	4,714	4,714
r2	0.0736	0.0847	0.0849	0.1031
Panel B (sons)	(1)	(2)	(3)	(4)
IV estimate	-0.0021*	-0.0020*	-0.0021*	-0.0021**
	(0.0011)	(0.0010)	(0.0011)	(0.0010)
Treatment * number of health posts	-0.0048	-0.0087**	-0.0090**	-0.0097**
	(0.0029)	(0.0039)	(0.0040)	(0.0044)
Year of child birth dummy	No	Yes	Yes	Yes
Water source (in survey year)	No	No	Yes	Yes
District specific linear time trend	No	No	No	Yes
N	2,570	2,570	2,570	2,570
r2	0.1113	0.1381	0.1396	0.1669
Panel C (daughters)	(1)	(2)	(3)	(4)
IV estimate	-0.0005	-0.0008	-0.0007	-0.0008
	(0.0008)	(0.0008)	(0.0008)	(0.0007)
Treatment * number of health posts	-0.0088***	-0.0032	-0.0032	-0.0028
	(0.0032)	(0.0040)	(0.0040)	(0.0038)
Year of child birth dummy	No	Yes	Yes	Yes
Water source (in survey year)	No	No	Yes	Yes
District specific linear time trend	No	No	No	Yes
N	2,144	2,144	2,144	2,144
r2	0.1005	0.1260	0.1282	0.1824

Note: All specifications include ethnicity indicator (Brahmin, Chettri, others), mother's age, father's literacy status, mother's literacy status, ward population, survey year indicator, year of birth fixed effects, and district of birth fixed effects. All regressions are weighted by household weights provided by the NLSS. Standard errors are presented in parenthesis and are clustered at the district level. * represent significant at the 10 %, ** at 5 %, and *** at 1 %.