Education does not seem to improve health: Evidence from Indonesia

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Abstract

I examine the effects of education on health in Indonesia using an exogenous variation in education induced by an extension of Indonesia's school term length in 1978-1979, a natural experiment that fits a regression discontinuity design. I find the longer school year increases educational attainment and wages, but I do not find evidence that education improves health. I explore some mechanisms through which education may affect health, but education does not seem to promote healthy lifestyles, increase the use of modern healthcare services, or improve access to health insurance; if anything, education improves only cognitive capacity.

Keywords: education, health, regression discontinuity design, Asia, Indonesia

JEL classification: H52, I12, I15, I21, I25

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1. Introduction

Early studies show more educated people are healthier, but evidence from recent papers that exploit natural experiments is mixed on whether the relationship is causal.[1] Papers that use instrumental variable techniques find education improves health, though their results vary by measure of outcomes; the few papers that use regression discontinuity (RD) designs—the closest empirical strategy to randomized experiments—are also inconclusive.[2] Using, respectively, the US, French, and British compulsory schooling laws in RD designs, Lleras-Muney (2005), Albouy and Lequien (2009), and Clark and Royer (2013) do not find education improves health; however, Oreopoulos (2006), using the US and British compulsory schooling laws, and Powdthavee (2010), the British, do. Among these RD papers, Clark and Royer's (2013) findings are perhaps the most convincing because they use a more refined assignment variable, the month of birth, which gives them more comparable

[1] For literature reviews of the early studies, see Goldman (2001) and Grossman and Kaestner (1997).

[2] The papers that use instrumental variable techniques use compulsory schooling laws, parental education, college expansions, unemployment rates, exemptions from military service, or draft lottery for the Vietnam war as instruments; they are, among others, Adams (2002), Arendt (2005), Berger and Leigh (1989), Braakmann (2011), Currie and Moretti (2003), Cutler and Lleras-Muney (2010), de Walque (2007), Grimard and Parent (2007), Jürges, Reinhold, and Salm (2011), and Lleras-Muney (2005). See also Cutler and Lleras-Muney (2012), Eide and Showalter (2011), and Grossman (2004) for reviews of this line of literature.

treated and control groups: They find very small and statistically insignificant effects of education on health, if at all.[3]

Even though these recent papers do not find education improves health in developed countries, the effects of education on health may vary by countries' stage of development and average educational attainment—it remains a question whether education improves health in developing countries like Indonesia, the country I examine in this paper.[4] One, people in developing countries are less educated and poorer; two, developing countries lack modern healthcare facilities, especially in rural areas where most people live. The first may imply education improves health if the health gain from education or the returns to education are large at low educational attainment. The second may mean education does not improve health because people in developing countries, even if they become more educated and richer, may have to travel to cities to use modern healthcare facilities, which may still be prohibitively costly.

Theories suggest education improves health, though not unambiguously. Becker and Mulligan (1997), for example, show education

[3] See also Braakmann (2011) and Jürges, Kruk, and Reinhold (2013). Both use the British compulsory schooling laws—the first paper interacts the laws with the CSE and O-level exams, the second uses biomarkers and self-reported health as measures of outcomes—the first does not find evidence education improves health, the second has results that vary by measure of outcomes.

[4] Most papers in this line of literature are on the effects of education on health in developed countries.

makes people become more patient about future incomes and prefer a longer and healthier life (education lowers their discount rates), which may increase their demand for good health. Grossman (1972) shows education helps people to learn the benefits and costs of healthy lifestyles and modern medication; because education improves cognitive ability, it also helps people to comprehend and comply with medical procedures—education increases health production function, which allows the more educated to have better health given the amount of health inputs that they consume. Grossman also argues education makes healthcare more affordable (because the more educated are richer) and allows the more educated to get better- and less risky jobs, or jobs that provide health insurance—education changes the optimal combination of health inputs, which is likely to improve the health of the more educated. These mechanisms suggest education improves health, but education also makes cigarettes and alcohol more affordable, health insurance may lead to moral hazard problems, and higher current incomes may induce the more educated to trade health for incomes in the short run, which complicate the theoretical predictions of the effects of education on health. Not only that theoretically education may improve health, health may also affect education (children who are sick when they grow up may be less educated) or some third factors affect both education and health (for example, parents who care about the education of their children may also care about the children's health).

In this paper, I examine the effects of education on health in Indonesia using a natural experiment, a one-time longer school year in Indonesia in

1978-1979, which fits a fuzzy RD design. Children who were born in 1972 or later (and entered primary schools in 1979 or later) did not experience the longer school year; those who were born earlier did if they did not drop out of schools before the 1978-1979 academic year. There is, therefore, a discontinuity in the probability of experiencing the longer school year around the 1971-1972 birth cohorts, which I use as an instrumental variable in a fuzzy RD design. The longer school year increases educational attainment by 0.7 of a year, the probability of completing senior high school (twelve-years of education) by 20-30%, and hourly wages by about 15% (Parinduri, 2014). In this paper, I use the exogenous increase in educational attainment induced by the longer school year to examine whether education improves health.

I do not find evidence that education improves health, promotes healthy lifestyles, or increases access to healthcare facilities and health insurance; if anything, education seems to improve only cognitive capacity. The estimates of the effects of education on self-reported health (such as whether a person considers herself healthy) are positive and those on objective measures of health conditions (such as whether she has hypertension) are negative (the expected sign if education improves health), but their magnitude is small and statistically insignificant. The estimates of the effects on health behavior (such as whether he smokes or eats fruits and vegetables daily) and on access to modern healthcare facilities (such as whether she has health insurance or does medical check up) have mixed signs, but they are also small and statistically insignificant. Among the measures of outcomes that I

consider, I find evidence that education improves only one aspect of health, cognitive capacity.

This paper contributes to the literature in four ways. One, I provide the causal effects of education on health using a natural experiment that fits an RD design, an empirical strategy that resembles randomized experiments the most (DiNardo and Lee, 2011). Two, the longer school year has a good design because (1) it affected most people in the relevant cohort, which would give estimates that are close to the population-average effects; and (2) it induced a large increase in education and wages later in life, much larger than what Clark and Royer (2013) or Oreopoulos (2006) exploit, which increases the likelihood of getting statistically significant results (if education affects health). Three, I examine the effects of education on health in a developing country whose educational attainment is low and healthcare facilities are lacking, which complements most papers in this line of literature that look at developed countries (the effects of education on health in developing countries may differ). Four, the data I use have various measures of health—not only self-reported and objectively measured health, but also health behavior, cognitive capacity, and access to health insurance and healthcare facilities. I could, therefore, explore some of the mechanisms through which education may affect health.

This paper proceeds as follows: Section 2 describes the longer school year; Section 3 presents the empirical strategy and data; Section 4 discusses the results; Section 5 concludes.

2. The longer school year in Indonesia

Some children in Indonesia experienced a one-time longer school year in the 1978-1979 academic year when the government of Indonesia changed the start of academic years in 1978. Academic years in Indonesia had started in January and ended in December the same year, but in mid-1978, the government changed the start of the academic year from January to July to, among others, synchronize the academic years with the government budget years. The government required schools in Indonesia to lengthen the 1978 academic year until June 1979. (From then on, academic years have started in July and ended in June the following year.) Therefore, children who were in schools in 1978 remained in the same grade until June 1979—these children experienced a one-time longer school year; children who entered primary schools in 1979 or later did not.

There is, therefore, a discontinuity in the probability of experiencing the longer school year between the 1978 and 1979 school cohorts, which correspond to the 1971 and 1972 birth cohorts (because most children in Indonesia entered primary schools the year they turned seven years old). People who were born in 1972 or later did not experience the longer school year because they had not entered primary schools in 1978 when the government implemented the longer school year; people who were born in 1971 or earlier experienced the longer school year if they did not drop out of schools before 1978. Conditional on the year of birth, there is a discontinuity in the probability of experiencing the longer school year between the 1971 and

1972 birth cohorts, which I use as an instrumental variable in a fuzzy RD design.

The government of Indonesia implemented the longer school year hastily.[5] It was announced in mid-1978 in the middle of the 1978 academic year and implemented immediately so that parents cannot precisely sort their children around the 1978 academic year. Therefore, the longer school year is a good RD design: I use it to generate exogenous changes in education, and then I examine the causal relationship between the exogenous changes in education and health.

3. Empirical strategy and data

3.1. Empirical strategy

I exploit an exogenous variation in education induced by a longer school year in Indonesia in the 1978-1979 academic year, which fits a fuzzy regression discontinuity (RD) design. (It fits a fuzzy RD design because not all people who were born in 1971 or earlier experienced the longer school year.) I implement the RD design using three-stage least-square estimations: (1) the first-stage regression of experiencing the longer school year on an instrumental variable, whether a person was born in 1971 or earlier, (2) the second- stage regression of educational outcomes on the predicted probability

[5] See, for example, Tempo (1978). See also Government of Indonesia (1985), MPKRI (1978), and some discussions of education policies in Indonesia in Samarakoon and Parinduri (2015).

of experiencing the longer school year, and (3) the third-stage regression of health outcomes on the predicted values of educational outcomes to estimate the effects of education on health.

I describe the RD design as follows. In the first-stage, I estimate

$$D_i = \alpha + \beta T_i + f(yob_i) + \varepsilon_{1i} \quad (1)$$

where D_i is an indicator of whether an individual *i* experienced the longer school year and zero otherwise, T_i is the instrumental variable, *older cohorts*, an indicator equals one if the individual *i* was born in 1971 or earlier, and $f(yob_i)$ is a polynomial function of the year of birth, yob_i. In the second-stage, to get the effects of the longer school year on education, I estimate

$$edu_i = \gamma + \delta \widehat{D}_i + f(yob_i) + \varepsilon_{2i} \quad (2)$$

where edu_i is a measure of educational outcomes of individual *i* such as her educational attainment or an indicator of high-school completion and $\widehat{D}_i$ is the predicted value of her probability of experiencing the longer school year from the first-stage regression, Equation (1). In the third-stage, to get the effects of education on health, I estimate

$$y_i = \gamma + \theta \widehat{edu}_i + f(yob_i) + \varepsilon_{3i} \quad (3)$$

where y_i is a measure of health of individual *i* and $\widehat{edu}_i$ is her predicted value of educational outcomes from the second-stage regression, Equation (2).

Identifications rely on the assumption that no other major policies were introduced in 1978-1979, which, I shall argue, is likely to hold. Indonesia's school construction program, Suharto's initiative to build schools throughout

the country funded by oil money in the 1970s, were initiated in 1973 (Duflo, 2004) and the program was slowed down in mid-1980s; the six-year compulsory schooling was announced in 1984; and the nine-year schooling was launched only in 1994—these policies, therefore, do not compromise the RD design. The longer school year might increase the school starting age, but I do some falsification tests using age as a measure of outcome and I find no discontinuity in the age of the people before and after the longer school year: The estimates of the effects of the longer school year on age are small and insignificant statistically. Other falsification tests also show no discontinuity in the likelihood that people lived in rural areas, the number of schools per day, the time it took for a one-way trip to schools, or the number of students in classrooms in 1978-1979.[6] Not only that the government did not implement other major education policies in 1971-1972 or 1978-1979, it did not introduce major changes in health policies either that might compromise the RD design.

This RD designs also rely on the assumption that parents did not *precisely* control the years their children entered primary schools (Lee and Lemeriux, 2010). Because the government announced the longer school year in mid-1978, it is unlikely that parents could sort their children precisely on either side of the discontinuity: One, the children that entered primary schools in 1978 were born six or seven years earlier; two, the policy was announced in

[6] See Parinduri (2014) for the details of the falsification tests and a discussion of other education policies implemented by the government of Indonesia since Indonesia's independence in 1945 until mid-1980s.

the middle of the 1978 academic semester and implemented immediately (children who were born in 1971 had entered primary schools in January 1978; children who were born in 1972 had yet to enter primary schools).

The coefficient of $\widehat{D}_i$ in Equation (2), δ, is the effects of the longer school year on education; the coefficient of $\widehat{edu}_i$ in Equation (3), θ, is the effects of education on health. If the longer school year increases education, we expect δ to be positive; if education improves health, we expect θ to be positive for outcomes like self-reported health and negative for outcomes like having hypertension.

3.2. Data

I use the Indonesia Family Life Survey (IFLS), a Rand Corporation's longitudinal survey of a representative sample of the Indonesian population.[7] I use IFLS-4, the latest wave of the survey done in 2007, to have the largest sample size of people who had completed high schools. I include people who were born in the 1960-1987 period so that the older cohorts had some likelihood of experiencing the longer school year in the 1978-1979 academic year and the younger cohorts had completed high schools when they were interviewed in 2007. I have about 18,500 people in the sample.

In the basic specifications, I define the longer school year using the year of birth. Children in Indonesia entered primary schools the year they

[7] See Frankenberg and Thomas (2000) and Strauss et al. (2009a) for the details of the survey.

turned seven years old so that if an individual was born in 1972 or later, she did not participate in the longer school year; if she was born in 1971 or earlier, she did experience the longer school year if she did not drop out of schools before 1978 when the government extended the length of the school year.

I also use the year of entry to primary schools to define the longer school year in some specifications because some students entered primary schools when they were six or eight years old. I prefer to use the year of birth to define the longer school year, however, because the information on the year of birth is more reliable. People in developing countries like Indonesia may not remember their birthdate, not to mention the year they entered primary schools. As Strauss et al. (2009b) explain, some people in the survey do not remember their birthdates and may give different dates in different books within a wave so that they have to use an algorithm to make sure that the year of birth is as accurate as possible.

I consider three groups of health outcomes: (1) health, (2) health behavior, and (3) access to insurance and modern health facilities. To measure the effects of education on health, I use self-reported health (health in general, healthy compared to peers, and had bed rest in the past four weeks), objectively measured physical health (hypertension, overweight, and obese), chronic illness incidence (ever diagnosed with chronic illness and had disabilities that limit work), and cognitive capacity (remember the date of the interview, the proportion of correct words remembered in a word-memorization exercise, and the proportion of correct word remembered a few

minutes later after the first memorization exercise is done).[8] I also use two measures of health behavior: smoking (ever smoke and currently smoke) and dietary behavior (take vitamins and supplements, eat vegetables daily, and eat fruits daily). As measures of access to healthcare, I use access to health insurance (have health insurance and have private health insurance) and modern health facilities (do medical check up, being treated by shamans, and receive inpatient care at hospitals or clinics). All variables are dummy variables except the measures of cognitive capacity using the memorization exercise. For example *healthy in general* equals one if an individual is healthy in general, it equals zero otherwise; currently smoke equals one if an individual currently smokes, it equals zero otherwise. The measures of cognitive capacity using the memorization exercise is the proportion of correct words remembered, which varies from zero to one; the bigger number, the larger her cognitive capacity.

The summary statistics in Table 1 does not show the expected effects of the longer school year on education. The younger cohorts, people who did

[8] The word memorization exercise is done as follows: (1) The interviewer tells the respondent that she will read a list of ten words that the respondent would need to memorize; (2) then she reads ten words slowly, around two seconds between each word (for example, the ten words are hotel, river, tree, skin, gold, market, paper, child, king, book—all in Bahasa Indonesia); (3) she asks the respondent to let her know the words that the respondent remembers in at most two minutes.

not experienced the longer school year, have higher educational attainment; a larger proportion of them completed high schools as well.

<Insert Table 1 here>

The table does not clearly show that education affects health either. If anything, the younger cohorts are healthier: Fewer of them are overweight or obese; they have higher cognitive capacity measured using the memorization exercise; they are also healthier in general. The older and younger cohorts do not seem to adopt different lifestyles: They are equally likely to currently smoke, take vitamins, or eat vegetables and fruits daily. The younger cohorts are more likely to have private health insurance and better access to modern healthcare facilities.

4. Results

First, I discuss the first-stage regressions (the effects of being born in 1971 or earlier (being in the *older cohorts*) on the probability of experiencing the longer school year) and the second-stage regressions (the effects of the longer school year on education). Then, I discuss the third-stage regressions, the effects of education on health, health behavior, and access to modern health facilities. To conclude, I do some robustness checks.

4.1. The effects of the longer school year on education

The top graphs of Figure 1, which illustrate the first-stage regressions, show that the trend lines of the proportion of people who experienced the longer school year break between the 1971 and 1972 cohorts: I can, therefore, use *older cohorts* (an indicator equals one for people who were born in 1971 or earlier) as an instrumental variable for the *longer school year* in a fuzzy RD design. Using the year of birth to define the longer school year (top-left graph), the probability of experiencing the longer school year increases as we move from the 1960 cohort to the 1971 cohort (from about 20% to almost 100%), but then it falls to zero for the younger cohorts: People in the older cohorts experienced the longer school year if they were still in schools when the government extended the school year in the 1978-1979 academic year; people in the younger cohorts did not. Using the year of entry to primary schools to define the longer school year (top-right graph), the trend line also breaks between the 1971 and 1972 cohorts: The proportion of people who experienced the longer school year falls from about 0.8 to 0.2.[9]

<Insert Figure 1 here>

The bottom graphs of Figure 1, which illustrate the reduced-form estimates, show the longer school year increases educational attainment (bottom-left graph) and the probability of completing high schools (bottom-

[9] These results, and the second-stage estimates, are similar to those in Parinduri (2014) who examines the effects of the longer school year on educational attainment and employment outcomes later in life.

right). The average educational attainment increases from about six years for the 1960s cohorts to ten years for the 1980s cohorts (the trend declines only for cohorts in the late-1980s), but the trend line breaks between the 1971 and 1982 cohorts. The same applies to the probability of completing high schools: The proportion of people who completed high schools increases from about 20% for the 1960s cohorts to 50% for the 1980s cohorts, but the trend line breaks between the 1971 and 1972 cohorts.

The first-stage estimates in Panel A of Table 2 confirm the break in the trend line of the proportion of people who experienced the longer school year that we see in Figure 1. Using the year of birth to define the longer school year (row 1), I find older cohorts who are just to the left of the discontinuity (that is, the 1971 cohort) are 100% more likely to experience the longer school year than the younger cohort just to the right of the discontinuity (that is, the 1972 cohort). (The estimates are similar regardless of whether I include year-of-birth cubic-polynomial function, age cubic-polynomial function, or gender and ethnicity dummies.) Using the year of entry to primary schools to define the longer school year (row 2), the probability of experiencing the longer school year falls by 88%. (The estimates are also similar across the three specifications.) All estimates are statistically significant with t-statistics that are bigger than eight.

<Insert Table 2 here>

The reduced-form estimates in Panel B also confirm the break in the trend line of educational attainment and the proportion of people who completed high schools that we see in Figure 1. Educational attainment falls by about 0.7 of a year; the probability of completing high schools falls by ten percentage points. The longer school year, therefore, increases educational attainment and the probability of completing high schools. (All estimates are statistically significant.)

The second-stage estimates in Panel C show the positive and economically large effects of the longer school year on educational attainment and the probability of completing high schools. The longer school year increases educational attainment by 0.7 of a year, which is a large gain, an eight percent increase, given that at the time the average educational attainment is only nine years. The longer school year increases the probability of completing high schools by nine percentage points, a 21% increase given that only 42% of people at the time completed high schools.

4.2. The effects of education on health

Figure 2, which illustrates the reduced-form estimates of the effects of the longer school year on some health outcomes, shows mixed results: The trend lines of the health measures seem to slightly break between the 1971 and 1972 cohorts, in particular that of cognitive capacity, though it is unclear whether the breaks are statistically significant. (I present the graphs of only four measures of outcomes for brevity.) As the trend lines show, younger cohorts

are healthier and less likely to suffer from hypertension or disabilities that limit work; they also have better cognitive capacity as the proportion of correct words that they remembered in a memorization exercise indicates. (The average index of health in general and the proportion of people with disabilities that limit work do not vary much by cohort, but the proportion of people with hypertension incidence and their cognitive capacity do: About 30% of people in the 1960 cohort have hypertension, less than 10% of the 1980s cohorts do; people in the 1960 cohort remember only 40% of the words in the memorization exercise, those in the 1980s cohorts do more than 50%.)

<Insert Figure 2 here>

Table 3 presents the reduced-form estimates of the effects of the longer school year, the second-stage estimates of the effects of the longer school year on health outcomes, and the third-stage estimates of the effects of educational attainment and completing high school on health outcomes.

<Insert Table 3 here>

The reduced-form and second-stage estimates of the effects of the longer school year in columns (1-2) confirm the findings in Figure 2. The longer school year increases self-reported health, both in general and compared to peers; it reduces the probability of having bed rest due to illness. It also improves physical health: It lowers the probability of having hypertension and being overweight or obese. The longer school year also lowers the probability of having disabilities that limit work, though it increases

the likelihood of being diagnosed with chronic illness. Moreover, it improves cognitive capacity measured using the proportion of the number words remembered in the memorization exercise, but it does not when cognitive capacity is measured using the date of the interview.

However, none of the estimates in columns 1-2 is statistically significant even at 10% level except the estimates of the effects on cognitive capacity measured using the word memorization exercise. Most estimates are either small (for example, had bed rest in the past few weeks, had hypertension, had chronic illness), or the standard errors are large (for example, were overweight, had disabilities that limit work). The estimates of the effects of the longer school year on cognitive capacity, on the other hand, are statistically significant at 1% level and economically large: The longer school year increases the proportion of correct words remembered by two percentage points, which equals a 4% increase in cognitive capacity. The effects of the longer school year on the proportion of the correct words remembered in a repeat exercise a few minutes later is similar, two percentage points, which is statistically significant at 5% level. (We should cautiously interpret these estimates, however, because none of them is statistically significant when I use Bonferroni-corrected standard errors.)

The third-stage estimates of the effects of educational attainment (column (3)) and completing high school (column (4)) show similar results: I do not find evidence that education improves health except cognitive capacity measured using the word-memorization exercise. Having one more year of

education increases cognitive capacity by two to three percentage points; completing high school increases cognitive capacity by about twenty percentage points, which is about a 40% increase. (The estimates of the effects of education on the proportion of correct words remembered in the first exercise are significant statistically at 1% level; those in the second exercise at 5% level.)

To summarize, I do not find evidence that the education improves self-reported health, physical health, or chronic illness incidence; I find evidence that education improves only cognitive capacity.

4.3. The effects education on health behavior

Even though I do not find education improves health except cognitive capacity, it is possible that I have insufficient statistical power to reject the null hypothesis or the effects are too small to be identified given the sample size or that people in the sample are not that old (younger than 45 years old). I, therefore, examine the effects of education in the short-term and medium term—the effects on health behavior (in this sub-section) and the effects on access to modern health facilities (in the next sub-section).

Figure 3, which illustrates the reduced-form estimates of the longer school year on health behavior, do not indicate that education matters. The cohort-specific proportions of people who currently smoke, take vitamins and supplements, or eat vegetables and fruits daily do not vary much. Between the 1971 and 1972 cohorts, he trend lines do not seem to break either.

<Insert Figure 3 here>

The estimates of the effects of education on smoking and dietary habits in Table 4 confirm the results: All estimates (the second-stage estimates of the effects of the longer school year as well as the third-stage estimates of the effects of educational attainment and completing high school) are statistically insignificant and economically small. The magnitude of the effects of completing high schools on smoking or eating vegetables and fruits daily, for example, is only 1-5 percentage points with standard errors 4-20 times larger (column 4). The estimate of the effects on taking vitamins and supplements is large, 14 percentage points, but the standard error is also large, 0.10 (column 4).

<Insert Table 4 here>

I do not find evidence that education improves health; I do not find evidence that education makes people adopt healthy lifestyles either. These results, therefore, indicate education may not improve health even in the long term through healthy lifestyles.

4.4. The effects of education on access to modern health facilities

Even though education does not induce people to adopt healthier lifestyles, it may help them to access modern health facilities, which may translate into healthier lives in the long term. Parinduri (2014), for example, shows that the longer school year improves employment outcomes later in life. If education,

through its effects on employment, increases the likelihood of having health insurance or better access to hospitals, education may eventually improve health.

Figure 4, which illustrates the reduced-form effects of the longer school year on access to private health insurance and modern health facilities, shows mixed results. The longer school year seems to increase the probability that people have private health insurance and to decrease the likelihood that they do general check up, but the data are noisy. There seems to be no effects on the probability of being treated by medical doctors or receiving inpatient care at hospitals or clinics either.

<Insert Figure 4 here>

The estimates in Table 5 show the same results: There is no evidence that education improves access to and increase the likelihood of using modern health facilities. (All estimates are statistically insignificant.) The magnitude of some estimates is also very small (for example, treated by shamans and receive inpatient care from hospitals or clinics). The other estimates are large (for example, the effects of completing high school on having private health insurance or on doing general check up, which are more than twenty percentage points), but their standard errors are also large.

<Insert Table 5 here>

4.5. Robustness checks

I do some robustness checks: I use higher polynomial functions of the year of birth and age to approximate the trends better; I use a more refined assignment variable, quarter of birth (instead of year of birth) to make people around the discontinuity more comparable; and I use the year of entry to primary schools to define the longer school year.

The estimates of the effects of education on health using additional control variables and alternative polynomial functions of the assignment variable in Table 6 show that overall the results are robust. In columns (1) and (5) I add age cubic polynomial; in columns (2) and (6) I add gender and ethnicity dummies further. In columns (3) and (7) I use the quadratic polynomial function of the assignment variable; in columns (4) and (8) the quartic polynomial. In most specifications, I do not find evidence that education improves health, health behavior, or access to modern health facilities. The only statistically significant estimates are those of the effects of education on cognitive capacity, which are significant at 1% level and similar across the different specifications: One year of education increases the proportion of correct words remembered by three percentage point (about 6%); completing high school leads to about twenty percentage point (40%) increase in cognitive capacity.

<Insert Table 6 here>

I then use a more refined assignment variable, quarter of birth instead of year of birth, but the results are similar.[10] Figure 5, which illustrates the reduced-form effects of the longer school year using the quarter of birth as the assignment variable, shows that the trend line of the proportion of individuals who completed high school between the 1971 and 1972 cohorts breaks, but we do not see breaks in the trend line of health in general or that of smoking incidence. If anything, there is only a slight break between the 1971 and 1972 cohorts in cognitive capacity measured using the word memorization exercise. Panel A of Table 7, which presents the third-stage estimates, confirms the trend lines: I do not find evidence that completing high school improves health, health behavior, or access to modern health facilities; if anything, it leads to a twenty percentage point (40%) increase in cognitive capacity measured by the proportion of words remembered in the memorization exercise.

<Insert Figure 5 here>

I also use alternative definitions of the longer school year, but overall the results are quite robust. (I present the third-stage estimates of completing high school only for brevity.) In row (2) of Table 7 I use year of birth as the assignment variable and year of entry to primary schools to define the longer school year; in row (3) I use year of entry to primary school to define the

[10] I also use month of birth and I find none of the estimates is statistically significant (though the data may be too noisy because my sample size is not very large). I do not present the results here for brevity.

longer school year and to be the assignment variable. I do not find evidence that completing high school affects health, health behavior, or access to modern health facilities, but I do find it improves cognitive capacity. The estimate in column (3) and row (2) is economically large, about twenty percentage points and statistically significant at 1% level; the estimate in row (3) is also economically large though it is significant at 10% level, which is probably because information on the year of entry to primary schools in the data is inaccurate.

<Insert Table 7 here>

It is possible that education matters for some sub-groups of people in the population, but overall the results of analyses by subsample are robust (Table 8). I find a few interesting details, however. (The table presents the results by sub-sample: the locations of individuals when they were twelve years old, gender, and the level of school they were attending when they experienced the longer school year.) One, the effects of education on cognitive capacity is mostly driven by the effects on people who grew up in rural areas: The estimate of the effects on people who grew up in rural areas is economically large and statistically significant; that of people who grew up in urban areas is small and statistically insignificant. (We should cautiously interpret these estimates, however, because I do multiple comparisons.) Two, the effects of education on cognitive capacity may be driven by the effects on females: The estimate of the effects on females is economically large and

statistically significant; that on males is also large, but statistically significant at 10% level only. Three, education seems to improve access to private health insurance for individuals who grew up in rural areas: The estimate is economically large and statistically significant at 1% level; that of urban is statistically insignificant. Four, focusing on sub-sample of people who were in primary schools when they experienced the longer school year, and on another sub-sample of people who were in primary school or junior high school, education seems to affect health in general: The estimates are economically large and statistically significant at 5% level.

<Insert Table 8 here>

5. Concluding remarks

Education does not seem to improve health; moreover, among the mechanisms (through which education may affect health) that I explore, none of them matters except cognitive capacity—education improves cognitive capacity, but it does not seem to promote healthy lifestyles, increase the use of modern healthcare services, or improve access to health insurance. The estimates of the effects of education on all measures of outcomes except cognitive capacity are small and statistically insignificant, results that are robust to the use of different polynomial functions, quarter of birth as the assignment variable, and alternative definitions of the longer school year; one more year of educational attainment, however, improves cognitive capacity by 6% (measured using the word memorization exercise). These results are mostly in line with the

findings in papers that use RD designs such as Albouy and Lequien (2009) and Clark and Royer (2013), in particular Clark and Royer who use a more refined assignment variable as I do in some specifications. The lack of evidence of causality between education and health in UK that Clark and Royer (2013) find seems to apply to developing countries like Indonesia whose average educational attainment is low and healthcare facilities are lacking.

The finding that education improves cognitive capacity is unsurprising (Falch and Massih, 2011). Higher educational attainment induced by the longer school year helps people learn how to rationally think and do simple arithmetic. Hence, more educated people are more able to do abstract thinking and recall facts that they learned in the past. Cognitive capacity is one of the health dimensions that closely relates to education; perhaps, that is why education improves cognitive capacity even though it does not others.[11]

My results imply governments in developing countries whose stage of development is like Indonesia's in the late 1970s should not assume that health returns to education are high when they decide how much to spend on public education and health. Perhaps they should not reallocate government budgets from public health to education either just because of the presumed high health

[11] Cutler and Lleras-Muney (2010), for example, find that knowledge and cognitive ability explain 30 percent of the relation between education and health; they study the relation in UK and US, however, not in developing countries. See also Auld and Sidhu (2005).

returns to education in developed countries (Groot and van den Brink, 2007) or the uncertain returns to healthcare spending (Weinsten and Skinner, 2010), at least until we learn more about the health returns to education in developing countries. These results also mean that we may need to reassess economic models that suggest large effects of education on health, in particular models that we use to analyze the relationship in developing countries.

Education may actually improve health: The estimates of the effects of education on health are positive; it is just that they are statistically insignificant. Perhaps, the magnitude of the effects of education on health is small to be identified or the sample size is insufficiently large to reject the null hypothesis of no effect. Or, perhaps, the effects of education on health are heterogeneous as the analyses by subsample suggest: Education may affect the health of people who grew up in rural areas, females, and those that experienced the longer school year when they were in primary or secondary schools. Perhaps education matters for health only in the long term when people are in their old age, the effects that I cannot examine because people in the data were in their late 30s or early 40s when the survey was done. Education does improve cognitive capacity, which may help people to live healthy lives in the long term. Besides, the estimates of the health returns to education I identify in this paper is the local average treatment effects: They tell us about the health returns to education of people that the longer school year compelled to stay in schools; the estimates do not say much about, for example, whether college education improves health and promotes healthy

lifestyles. De Walque (2007), for example, finds college education reduces smoking incidence, results that may also apply to developing countries like Indonesia but I cannot explore using the exogenous changes in education induced by the longer school year.

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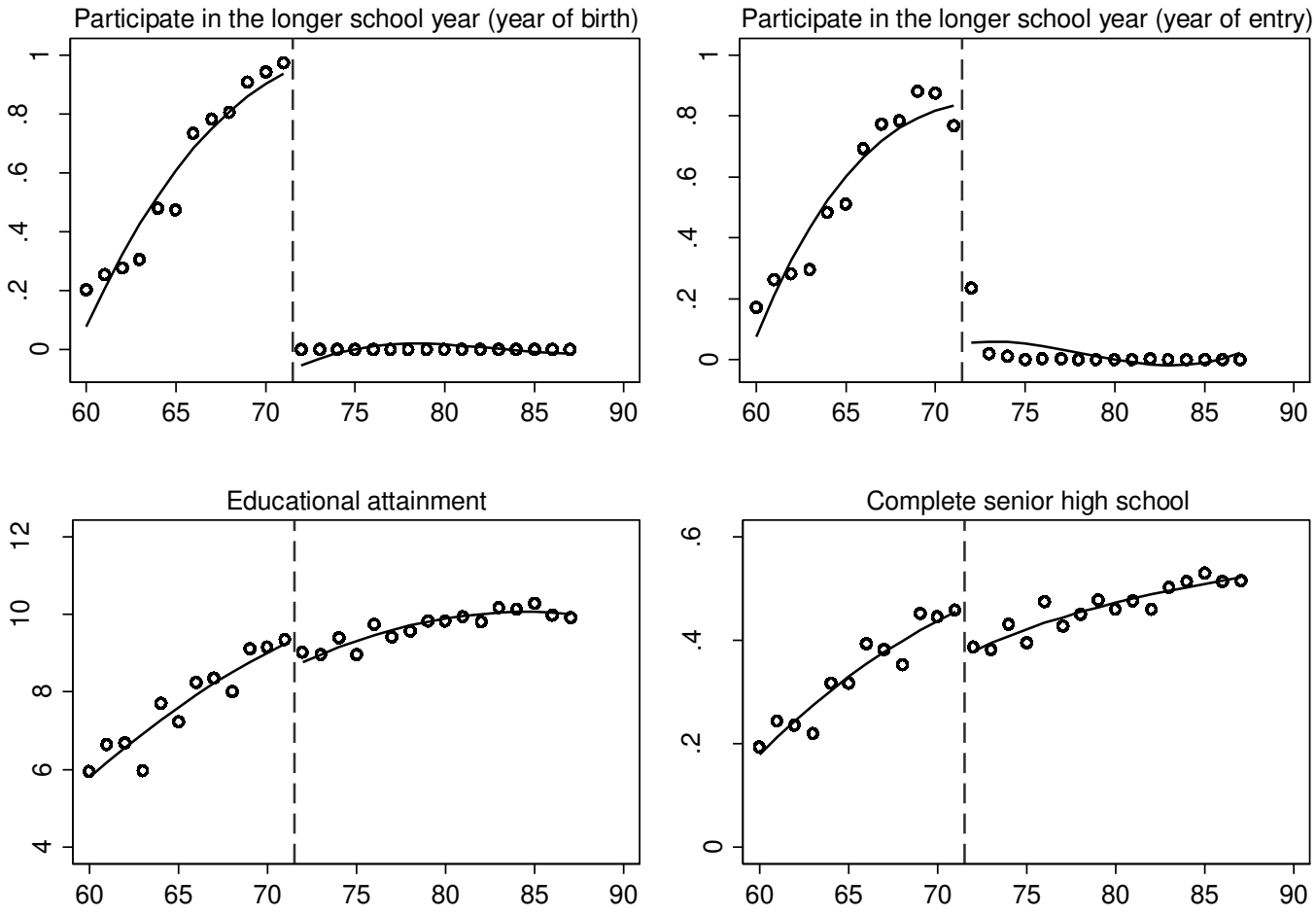

Figure 1 The longer school year and its effects of education

Note: The horizontal axis in each graph is the year of birth; the vertical dash line is the discontinuity between the 1971- and 1972 birth cohorts.

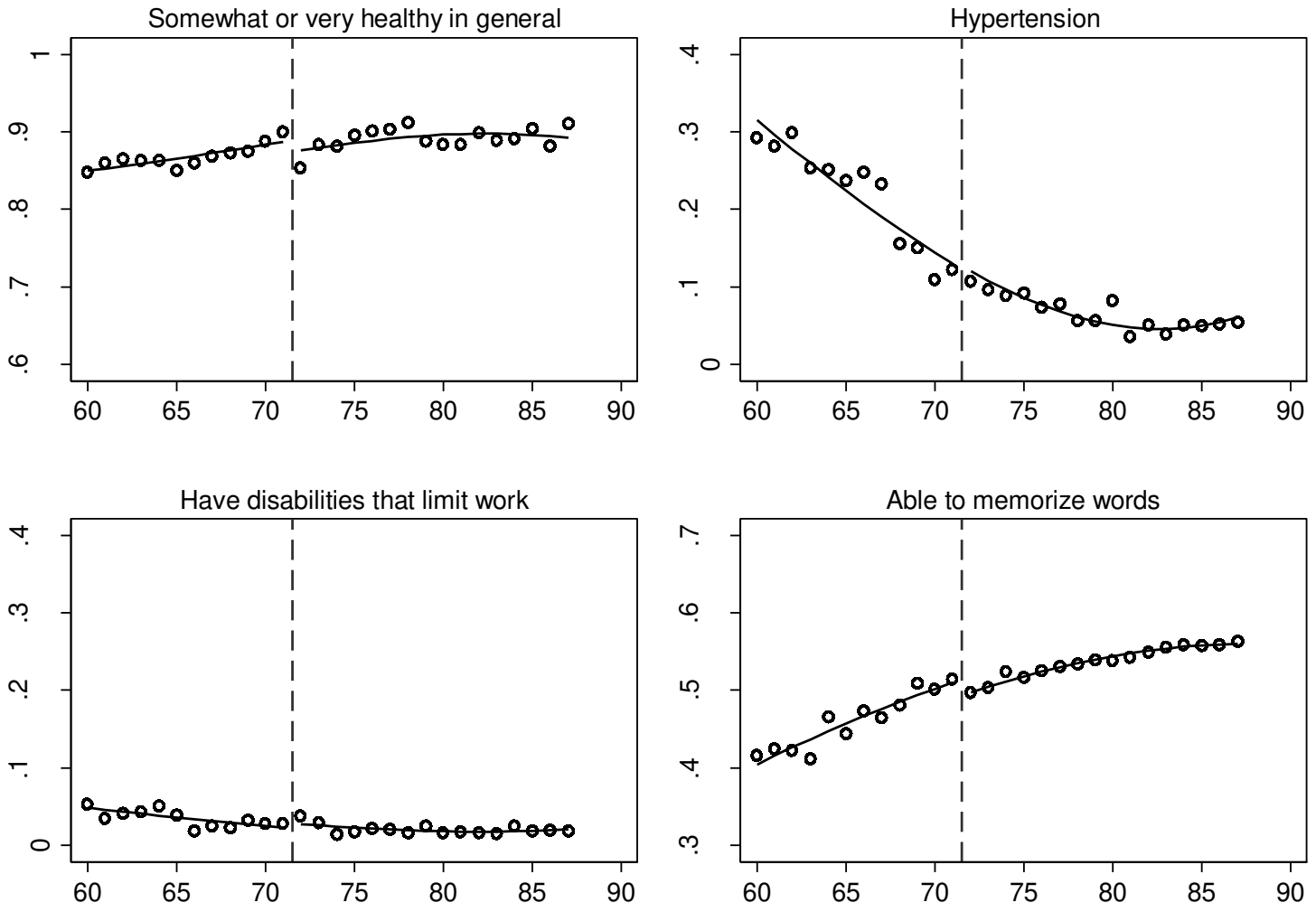

Figure 2 The effects of the longer school year on heatlh

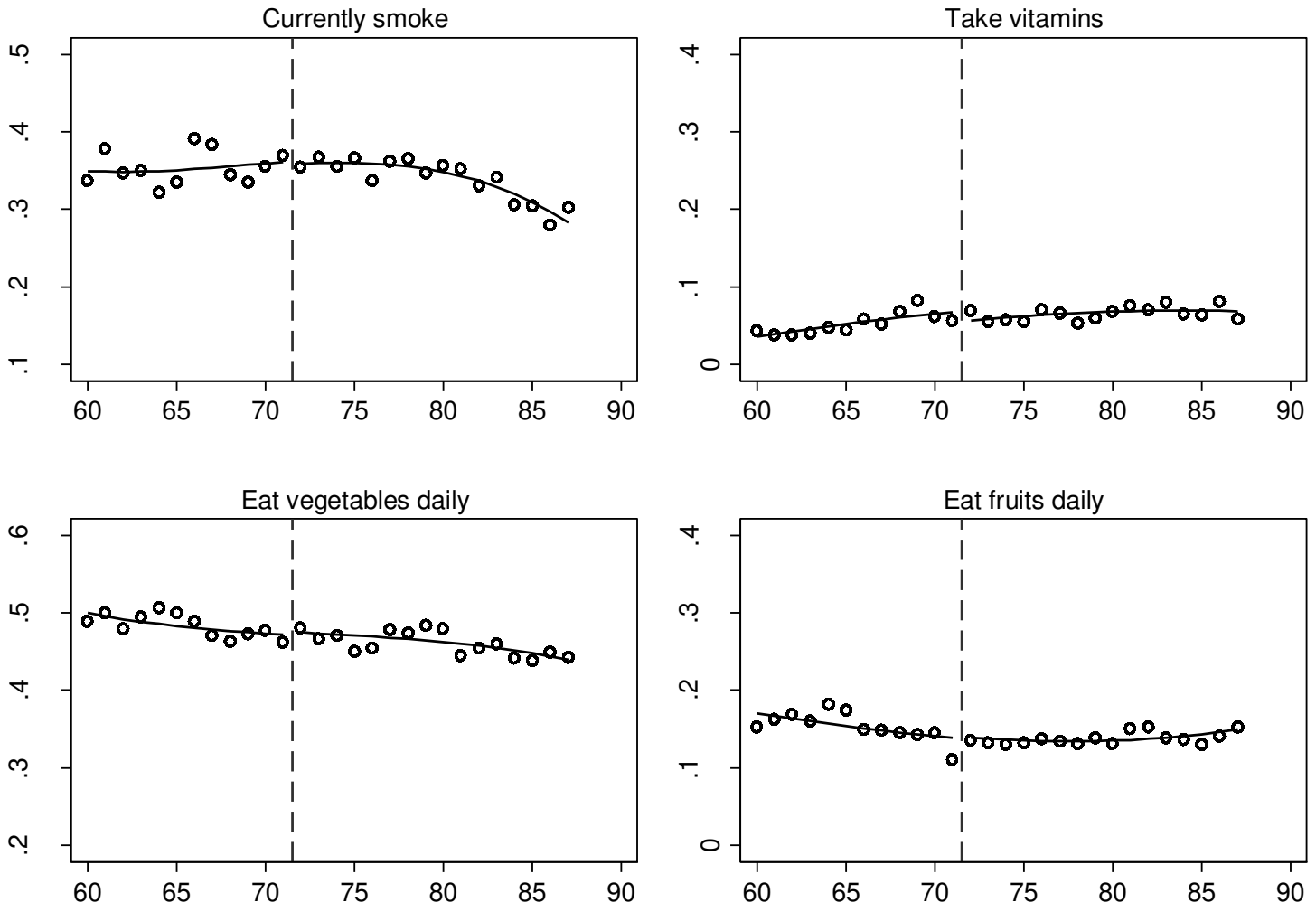

Figure 3 The effects of the longer school year on heatlh behavior

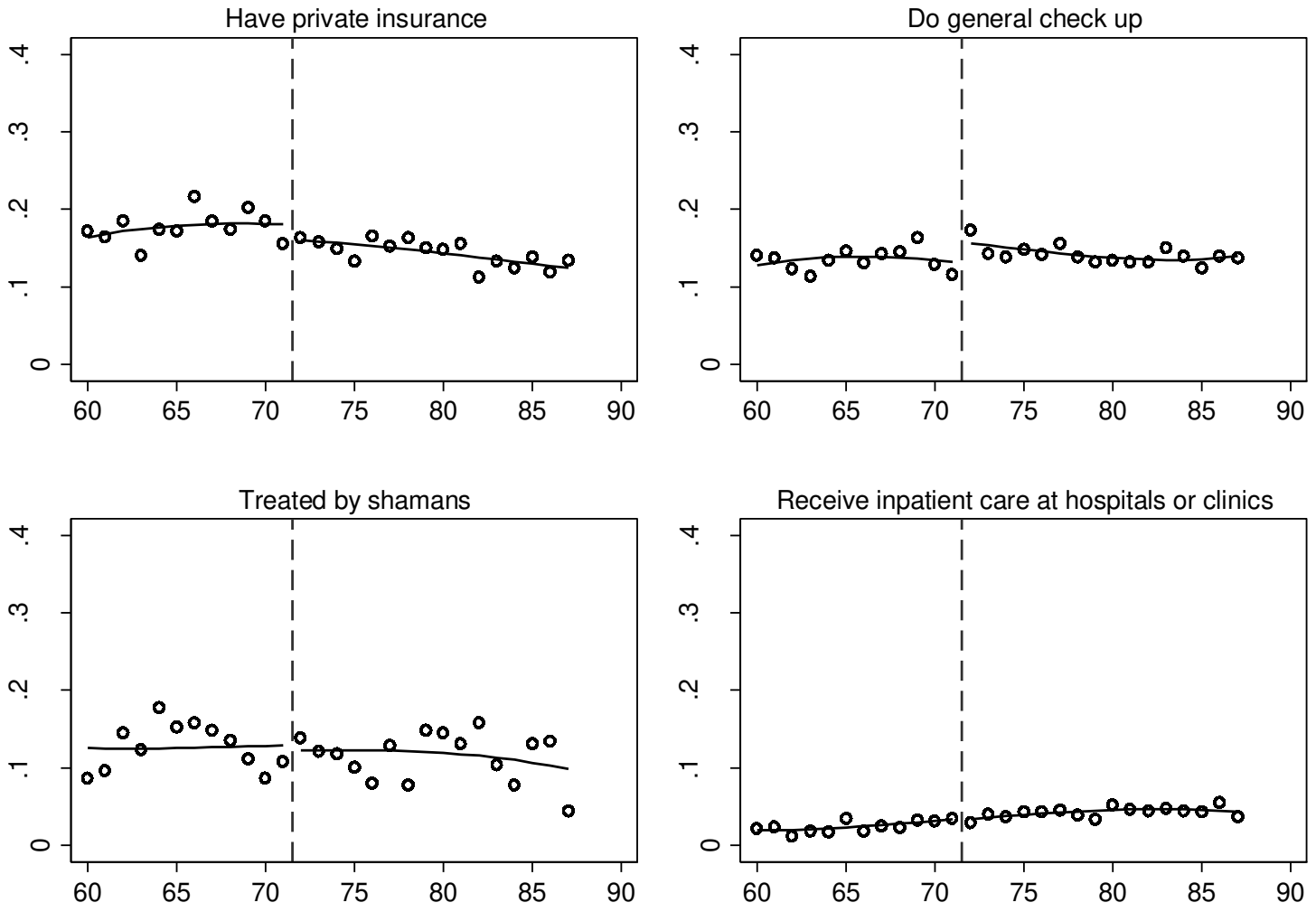

Figure 4 The effects of the longer school year on access to insurance and modern health facility

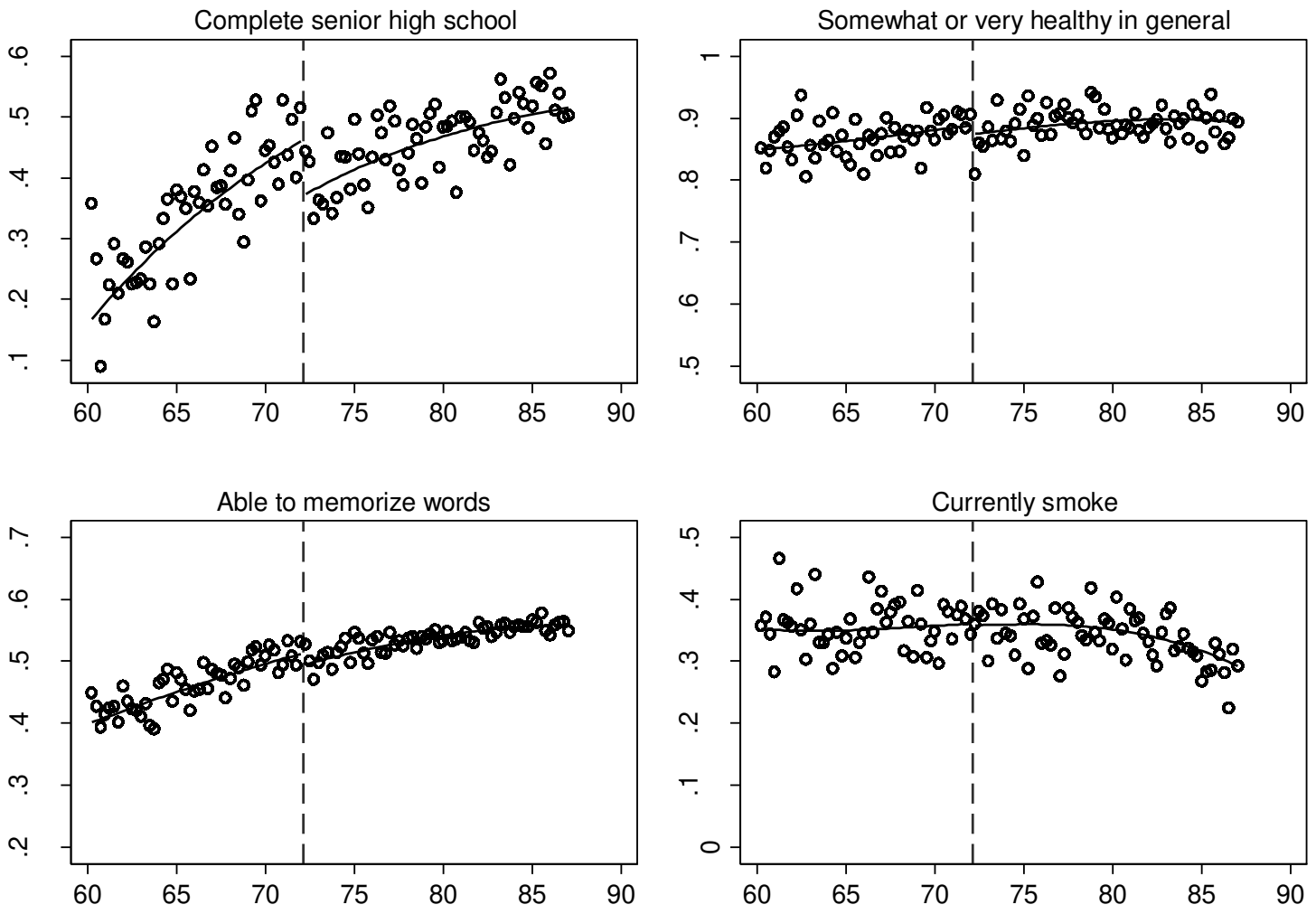

Figure 5 Using quarter of birth as the assignment variable

Table 1 Summary statistics

Variable	1972-1987 cohorts	1960-1971 cohorts	1960-1987 cohorts
A. Educational outcomes			
Educational attainment	9.71	7.77	9.05
	(3.84)	(4.84)	(4.30)
Complete high school	0.46	0.34	0.42
	(0.50)	(0.47)	(0.49)
B. Health outcomes			
Healthy in general	0.89	0.87	0.88
	(0.31)	(0.34)	(0.32)
Healthy compared to peers	0.95	0.94	0.94
	(0.22)	(0.24)	(0.23)
Had bed rest in the past four weeks	0.07	0.06	0.06
	(0.25)	(0.23)	(0.24)
Hypertension	0.07	0.21	0.12
	(0.25)	(0.41)	(0.32)
Overweight	0.23	0.37	0.28
	(0.72)	(0.96)	(0.81)
Obese	0.05	0.09	0.06
	(0.35)	(0.47)	(0.39)
Ever diagnosed chronic illness	0.05	0.08	0.06
	(0.22)	(0.28)	(0.24)
Have disabilities that limit work	0.02	0.04	0.03
	(0.14)	(0.18)	(0.16)
Remember today's date	0.99	0.95	0.97
	(0.11)	(0.22)	(0.16)
Able to memorize words	0.54	0.46	0.51
	(0.16)	(0.18)	(0.17)
Able to memorize the words a few minutes later	0.44	0.36	0.42
	(0.19)	(0.20)	(0.19)
C. Health behaviour			
Ever smoke	0.36	0.38	0.36
	(0.48)	(0.48)	(0.48)
Currently smoke	0.34	0.35	0.34
	(0.47)	(0.48)	(0.48)
Take vitamins and suplements	0.07	0.05	0.06
	(0.25)	(0.23)	(0.24)
Eat vegetables daily	0.46	0.48	0.47
	(0.50)	(0.50)	(0.50)
Eat fruits daily	0.14	0.15	0.14
	(0.35)	(0.36)	(0.35)
D. Access to insurance and modern health facilities			
Have health insurance	0.24	0.30	0.26
	(0.42)	(0.46)	(0.44)
Have private health insurance	0.14	0.18	0.15

	(0.35)	(0.38)	(0.36)
Do check up	0.14	0.14	0.14
	(0.35)	(0.34)	(0.35)
Treated by shamans	0.12	0.12	0.12
	(0.32)	(0.33)	(0.33)
Receive inpatient care at hospitals or clinics	0.04	0.03	0.04
	(0.20)	(0.16)	(0.19)

Notes: The number in each cell is the mean. The figures in parentheses are standard deviations.

Table 2 First-stage, reduced form, and the second-stage regressions

		(1)	(2)	(3)
A. First-stage regression				
1. Using year of birth to define longer school year				
Older cohorts	(1)	1.02**	1.02**	1.02**
		(0.04)	(0.04)	(0.04)
Adjusted R^2		0.67	0.67	0.67
Number of observations		18,584	18,584	18,584
2. Using year of entry to define longer school year				
Older cohorts	(2)	0.88**	0.88**	0.88**
		(0.11)	(0.11)	(0.11)
Adjusted R^2		0.65	0.65	0.65
Number of observations		16,735	16,735	16,735
B. Reduced form				
1. Educational attainment				
Older cohorts	(3)	0.69**	0.70**	0.66**
2. Complete senior high school		(0.23)	(0.23)	(0.20)
Older cohorts	(4)	0.09**	0.09**	0.09**
		(0.02)	(0.02)	(0.02)
C. 2SLS				
1. Educational attainment				
Older cohorts	(5)	0.67**	0.68**	0.65**
2. Complete senior high school		(0.21)	(0.20)	(0.18)
Older cohorts	(6)	0.09**	0.09**	0.09**
		(0.02)	(0.02)	(0.01)
Controls				
Year-of-birth cubic polynomial		✓	✓	✓
Age cubic polynomial			✓	✓
Gender and ethnicity dummies				✓

Notes: The number in each cell is the estimate of *older cohorts* from a separate regression of *longer school year* or education on *older cohorts* and a set of control variables. In Panel A, *longer school year* equals one if an individual was born in 1971 or earlier and was still in schooling in 1978; it equals zero otherwise. In Panel B, *longer school year* equals one if an individual entered a primary school in 1978 or earlier and was still in schooling in 1978. The number in each cell in Panel B is the reduced form estimate of longer school year defined using the year of birth; that in Panel C is the corresponding 2SLS estimate. *Older cohorts* equals one if an individual was born in 1971 or earlier. The figures in parentheses are robust standard errors clustered by year of birth. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 3 The effects of education on health

Dependent variable		Reduced form	The effects of		
			Longer school year	Educational attainment	Completing high school
		(1)	(2)	(3)	(4)
A. Self-reported health					
Healthy in general	(1)	0.02	0.02	0.02	0.16
		(0.01)	(0.01)	(0.02)	(0.13)
Healthy compared to peers	(2)	0.01	0.01	0.02	0.15
		(0.01)	(0.01)	(0.01)	(0.10)
Had bed rest in the past four weeks	(3)	-0.01	-0.004	-0.01	-0.05
		(0.01)	(0.01)	(0.01)	(0.10)
B. Physical health					
Hypertension	(4)	-0.003	-0.003	-0.004	-0.03
		(0.02)	(0.02)	(0.02)	(0.13)
Overweight	(5)	-0.02	-0.02	-0.02	-0.18
		(0.03)	(0.03)	(0.05)	(0.34)
Obese	(6)	-0.01	-0.01	-0.01	-0.09
		(0.01)	(0.01)	(0.02)	(0.16)
C. Chronic illness					
Ever diagnosed chronic illness	(7)	0.004	0.003	0.01	0.04
		(0.01)	(0.01)	(0.01)	(0.10)
Have disabilities that limit work	(8)	-0.01	-0.01	-0.01	-0.06
		(0.01)	(0.01)	(0.01)	(0.07)
D. Cognitive capacity					
Remember today's date	(9)	0.01	0.01	0.01	0.06
		(0.01)	(0.01)	(0.01)	(0.06)
Able to memorize words	(10)	0.02**	0.02**	0.03**	0.22**
		(0.01)	(0.01)	(0.01)	(0.07)
Able to memorize the words a few minutes later	(11)	0.02*	0.02*	0.02*	0.17*
		(0.01)	(0.01)	(0.01)	(0.08)

Notes: The number in each cell in column (1) is the estimate of *older cohorts* in a regression of a health outcome on *older cohorts* and the year-of-birth cubic polynomial. Each cell in columns (2-4) is the corresponding 2SLS estimate of the effects of the longer school year and educational attainment, respectively. Each cell in column (4) is the equation-by-equation 2SLS estimate of completing high school. The dependent variables are listed on the left column. *Older cohorts* equals one if an individual was born in 1971 or earlier. The figures in parentheses in columns (1-2) are robust standard errors clustered by year of birth; those in columns (3-4) are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 4 The effects of education on health behavior

Dependent variable		Reduced form	The effects of		
			Longer school year	Educational attainment	Completing high school
		(1)	(2)	(3)	(4)
A. Smoking					
Ever smoke	(1)	0.001	0.001	0.002	0.01
		(0.01)	(0.01)	(0.03)	(0.20)
Currently smoke	(2)	0.003	0.003	0.01	0.04
		(0.01)	(0.01)	(0.03)	(0.20)
B. Diet					
Take vitamins and suplements	(3)	0.01	0.01	0.02	0.14
		(0.01)	(0.01)	(0.01)	(0.10)
Eat vegetables daily	(4)	-0.01	0.00	-0.01	-0.05
		(0.01)	(0.01)	(0.03)	(0.21)
Eat fruits daily	(5)	-0.001	-0.002	-0.003	-0.02
		(0.01)	(0.01)	(0.02)	(0.14)

Notes: The number in each cell in column (1) is the estimate of *older cohorts* in a regression of a health outcome on *older cohorts* and the year-of-birth cubic polynomial. Each cell in columns (2-4) is the corresponding 2SLS estimate of the effects of the longer school year and educational attainment, respectively. Each cell in column (4) is the equation-by-equation 2SLS estimate of completing high school. The dependent variables are listed on the left column. *Older cohorts* equals one if an individual was born in 1971 or earlier. The figures in parentheses in columns (1-2) are robust standard errors clustered by year of birth; those in columns (3-4) are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 5 The effects of education on access to insurance and modern health facilities

Dependent variable		Reduced form	The effects of		
			Longer school year	Educational attainment	Completing high school
		(1)	(2)	(3)	(4)
A. Health insurance					
Have health insurance	(1)	0.02	0.02	0.02	0.17
		(0.02)	(0.01)	(0.02)	(0.18)
Have private health insurance	(2)	0.02	0.02	0.03	0.21
		(0.01)	(0.01)	(0.02)	(0.14)
B. Access to modern facilities					
Do check up	(3)	-0.03	-0.03	-0.04	-0.27
		(0.01)	(0.01)	(0.02)	(0.16)
Treated by shamans	(4)	-0.003	0.001	0.001	0.01
		(0.03)	(0.02)	(0.06)	(0.25)
Receive inpatient care at hospitals or clinics	(5)	0.002	0.001	0.002	0.01
		(0.004)	(0.004)	(0.01)	(0.08)

Notes: The number in each cell in column (1) is the estimate of *older cohorts* in a regression of a health outcome on *older cohorts* and the year-of-birth cubic polynomial. Each cell in columns (2-4) is the corresponding 2SLS estimate of the effects of the longer school year and educational attainment, respectively. Each cell in column (4) is the equation-by-equation 2SLS estimate of completing high school. The dependent variables are listed on the left column. *Older cohorts* equals one if an individual was born in 1971 or earlier. The figures in parentheses in columns (1-2) are robust standard errors clustered by year of birth; those in columns (3-4) are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 6 Using additional control variables and alternative polynomial functions of the assignment variable

Dependent variable		The effects of educational attainment				The effects of completing high school			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Healthy in general	(1)	0.02	0.02	0.01	0.03	0.16	0.17	0.09	0.26*
		(0.02)	(0.02)	(0.02)	(0.02)	(0.13)	(0.14)	(0.10)	(0.14)
Hypertension	(2)	-0.004	-0.001	0.01	-0.03	-0.03	-0.01	0.07	-0.22
		(0.02)	(0.02)	(0.01)	(0.02)	(0.13)	(0.14)	(0.09)	(0.13)
Able to memorize words	(3)	0.03**	0.03**	0.03**	0.03**	0.22**	0.21**	0.17**	0.27**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.07)	(0.07)	(0.05)	(0.07)
Currently smoke	(4)	0.004	0.03	-0.02	0.01	0.03	0.19	-0.11	0.04
		(0.03)	(0.02)	(0.02)	(0.02)	(0.19)	(0.15)	(0.14)	(0.19)
Take vitamins	(5)	0.02	0.02	0.02	0.01	0.14	0.13	0.12	0.11
		(0.01)	(0.01)	(0.01)	(0.01)	(0.10)	(0.10)	(0.07)	(0.10)
Have private health insurance	(5)	0.03	0.03	0.04*	0.03	0.21	0.21	0.23*	0.22
		(0.02)	(0.02)	(0.02)	(0.02)	(0.14)	(0.14)	(0.10)	(0.14)
Treated by shamans	(5)	0.002	0.0002	0.002	-0.06	0.01	0.001	0.01	-0.32
		(0.06)	(0.04)	(0.09)	(0.06)	(0.25)	(0.21)	(0.25)	(0.28)
Controls									
Year-of-birth quadratic polynomial				✓				✓	
Year-of-birth cubic polynomial		✓	✓			✓	✓		
Year-of-birth quartic polynomial					✓				✓
Age cubic polynomial		✓	✓			✓	✓		
Gender and ethnicity dummies			✓				✓		

Notes: The number in each cell in columns (1-4) is the the equation-by-equation 2SLS estimate of the effects of educational attainment; that in columns (5-8) is the equation-by-equation 2SLS estimate of the effects of completing high school, respectively. The dependent variables are listed on the left column. The figures in parentheses are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 7 Using alternative assignment variables and definitions of longer school year

Dependent variable		Healthy in general	Hyper-tension	Able to memorize words	Currently smoke	Take vitamins	Have private health insurance	Treated by shamans
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Assignment variable: quarter of birth								
Longer school year (using year of birth)	(1)	0.16	-0.02	0.21**	0.04	0.14	0.19	0.0004
		(0.14)	(0.13)	(0.07)	(0.20)	(0.10)	(0.14)	(0.26)
2. Assignment variable: year of birth								
Longer school year (using year of entry)	(2)	0.16	-0.01	0.19**	0.09	0.13	0.18	-0.07
		(0.14)	(0.13)	(0.07)	(0.20)	(0.10)	(0.15)	(0.23)
3. Assignment variable: year of entry								
Longer school year (using year of entry)	(3)	0.25	-0.32	0.25	0.50	0.03	0.42	-0.33
		(0.28)	(0.30)	(0.15)	(0.45)	(0.20)	(0.30)	(0.51)

Notes: The number in each cell is the equation-by-equation 2SLS estimate of the effects of completing high school. The dependent variables are listed on the top row. The figures in parentheses are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.

Table 8 The effects of education by sub-sample

Dependent variable		Healthy in general	Hyper-tension	Able to memorize words	Currently smoke	Take vitamins	Have private health insurance	Treated by shamans
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. By location at twelve years old								
Rural	(1)	0.17	-0.12	0.27**	0.33	0.08	0.43**	0.51
		(0.16)	(0.16)	(0.09)	(0.25)	(0.11)	(0.16)	(1.20)
Urban	(2)	0.18	0.28	0.03	-0.65	0.27	-0.48	-0.14
		(0.31)	(0.33)	(0.16)	(0.50)	(0.27)	(0.49)	(0.22)
B. By gender								
Males	(3)	-0.08	-0.07	0.27	0.65	0.09	0.24	-0.16
		(0.30)	(0.33)	(0.18)	(0.59)	(0.24)	(0.34)	(0.65)
Females	(4)	0.27	0.01	0.19**	-0.01	0.16	0.20	0.10
		(0.15)	(0.12)	(0.07)	(0.05)	(0.10)	(0.14)	(0.26)
C. By type of schools								
Primary schools	(5)	0.47*	-0.02	0.25**	-0.003	-0.02	-0.02	-0.27
		(0.21)	(0.17)	(0.10)	(0.26)	(0.13)	(0.20)	(0.26)
Primary- or junior high schools	(6)	0.51*	-0.13	0.25**	-0.01	-0.02	0.10	-0.29
		(0.20)	(0.17)	(0.09)	(0.24)	(0.12)	(0.18)	(0.24)

Notes: The number in each cell is the equation-by-equation 2SLS estimate of the effects of completing high school. The dependent variables are listed on the top row. The figures in parentheses are standard errors. One and two stars indicate statistical significance at a level of five and one percent, respectively.