High School Dropout and Teen Childbearing

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Abstract:

In this paper I examine the relationship between high school dropout and teen childbearing. Understanding this relationship is complicated because both phenomena are likely affected by a variety of difficult to control factors. Using a panel data on aggregate dropout and fertility rates by age for all fifty states, I attempt to develop insight by instrumenting for dropout using information on state policies on mandatory high school graduation exams. I then make use of the set of exit exam instruments in tandem with an instrument used previously in the literature to identify the impact of education on a variety of outcomes: Compulsory schooling laws. Because these instruments operate at different margins, comparing effects estimated provides insight into whether local average treatment effects identified are informative about average treatment effects relevant for a broader population than those complying with either instrument. The findings suggest that the elasticity of teen pregnancy with respect to high school dropout is 0.13 for white teens and 0.25 for black teens.

Introduction

The relationship between high school dropout and risky adolescent behavior is as substantial in magnitude as it is complex. Researchers from a variety of disciplines have long understood that in addition to its effects on employment and earnings, dropout leads to a number of poor outcomes and associated risky behavior. For example, dropouts are at greater risk for mental health problems (Liem et al., 2010), alcohol use (McCaul et al., 1992), and delinquency (Sweeten et al., 2009). At the same time, it is clear that risky behavior negatively affects educational achievement and increases risk of dropout (Chatterji and Desimone, 2005; Cook and Moore, 1993). Because neither high school dropout nor risky adolescent behavior can be controlled by the researcher, all work in this area relies on observational data. Further, because there are myriad theoretical linkages between adolescent risky behavior and education, there are competing explanations for the patterns that are observed. As a result, sorting out causal relationships in this area can be especially hard.

Absent the ability to sort out the structural relationship between poor academic performance and risky behavior, researchers are even at a loss to develop reduced form tests that would permit us to identify plausible and convincing estimates of causal parameters in one direction or the other. In this paper I hope to contribute to the collective advance toward that goal. Specifically, I attempt to add to what is known about the relationship between high school dropout and teen childbearing in two ways. First, I introduce a new instrument to the literature: The implementation of a set of mandatory high school graduation exams in the United States over the past few decades. "Exit exams," as these tests are known, have become more common, and more difficult.

These exams are controversial, with opponents claiming they will drive marginal students out of school, and proponents arguing they will align student interests with those of the school and will encourage teachers and principals to provide effort and resources on the students' behalf. I make use of the fact that when states implement these exams, they announce them well in advance to begin with a particular graduating class. So within a state, some students in high school will be required to pass these exams, while students in the grade above will not. The exposure of some students to new graduation requirements provides a source of variation affecting high school dropout which is plausibly exogenous to other factors shaping risky adolescent sexual behavior.

Second, I then make use of the exit exam instrument in tandem with an instrument used previously in the literature to identify the impact of education on a variety of outcomes: Compulsory schooling laws.[1] Because compulsory schooling laws and high school exit exams operate at different margins, comparing effects estimated off of different instruments provides insight into whether local average treatment effects identified with either instrument are informative about average treatment effects that would be pertinent to a broader population than those complying with the instrument.

In the sections that follow, I first discuss high school dropout and teen childbearing and the empirical and theoretical links between them. I then describe the data and strategy employed here for identifying the relationship between rates of high school dropout rates and teen childbearing. I then summarize empirical findings, and consider the case for and magnitude of a causal relationship between dropout and criminal behavior.

[1] Laws governing the minimum and maximum ages at which children are required to be enrolled in school necessarily shape children's educational attainment conditional on age, but are not likely related to other factors shaping risky behavior.

Background

Previous Literature

The positive and substantial relationship between education and earnings is a well-established empirical fact, and fundamental to theoretical foundations of labor economics (see Card, 1999 for a review). So, the consequences of high school dropout on employment and earnings outcomes have been estimated across a variety of settings. Estimates using data the U.S., Canada, and the U.K. are that each year of schooling lost by high school dropouts reduces annual wage earning by 7 to 10 percent (Angrist and Krueger, 1991; Campoliete, et al., 2010, and; Oreopoulos, 2007), as well as reducing the likelihood of employment.

The economic consequences of dropout extend beyond direct labor market effects. Young people who forego a year of high school are more likely than comparable peers to have a mental health problem, report poor physical health, have marital problems, live in poverty, and commit crimes or be incarcerated (Oreopolous, 2007; Oreopolous and Salvanes, 2011), and Lochner and Moretti, 2004). Further, Lleras-Muney (2005) estimates impact of lost school years are long-lasting, affecting age of mortality among older Americans. The persistent and substantial rate of high school dropout in the U.S. makes the importance of research like this to identify the consequences of high school dropout obvious. Each year, approximately 660,000 American students drop out of public high schools.[2]

One consequence of high school dropout that has received limited attention is the potential impact on teen childbearing. There are a number of reasons to expect that

[2] This estimate based on applying the 4.4% total event dropout rate for all high school students reported by the National Center of Education Statistics to total 2007 Fall enrollment of 15 million (NCES, 2010).

adolescents who drop out of high school are at greater risk for unintended pregnancy and teen childbearing. The first is that teens, free from the structured environment of a high school, are more likely to engage in unproductive and even risky behavior. That is, schools have a direct effect on behavior via an incapacitation or incarceration effect on adolescents (Jacob and Lefgren, 2003). Second, by disrupting the development of human capital, dropping out of high school lowers the opportunity cost of teen childbearing. Additionally, education may affect the ability of teens to understand and use information that directly affects health outcomes.[3] For example, education could affect the ability of teens to assess information on the risks of unprotected sex, or how to access or use various forms of contraception (Rosenzweig and Schultz, 1989).

Understanding whether and how education can affect the teen childbearing is important because of the substantial and lasting consequences of teen childbearing. However, the effects of childbearing on teen girls, *per se,* are hard to separate from other factors that shape the propensity to have a child as well as other outcomes. Estimates that rely on basic regression adjusting substantially overstate impacts (Geronimus and Korenman, 1992). Nonetheless, there is some evidence that having a child has negative impacts on later employment outcomes of adolescent girls (Angrist and Evans, 1996) and on later educational decisions (Hoffman, 2008). However, identifying treatment effects by comparing girls giving birth while a teen to those whose first birth was delayed by a miscarriage rather than abstinence, prevention or luck, Hotz et al. (2005) find no effects of teen childbearing on later outcomes for teen mothers.

[3] Economists have long recognized that education plays a role in increasing efficiency in non-market production (Becker, 1965), and have expanded this to include efficiency in producing health outcomes Grossman, 1972, 1975) and interpreting and allocating multiple inputs to generate better health outcomes (Rosenzweig and Schultz, 1982; Kenkel, 1991).

It is clear, however, that there are real and negative effects of being born to a teen mother. Children born to teen mothers fare more poorly in school (Angrist and Lavy, 1996; and Manlove et al., 2008), and are at greater risk for neglect and contact with the foster care system (Goerge, et al., 2008). Children of teen mothers are also more likely to come into contact with the corrections system: Grogger (2008) estimates that a delay in age at first birth from 16 to just over 20 would reduce the likelihood of a son's incarceration by about 12 percent. Maynard and Hoffman (2008) add up costs like these and estimate that teen childbearing costs U.S. taxpayers about $7.3 billion annually.

Despite the important negative consequences of adolescent childbearing, and the potential role of education in forestalling age at first birth, there has been little work on the question of whether keeping kids in school can help result in fewer births to teenagers. What is known comes from two studies, which reach somewhat different conclusions. McCrary and Royer (2006) use administrative data on all births in California and Texas over a period of more than a decade to examine the impact of age at school on fertility and infant health. Using a regression-discontinuity design they exploit differences in school starting age which shapes the number of years of schooling girls are exposed to. They find that education has no significant effect on fertility.

Black et al (2008) use data on a broader sample of women, drawn from all women born in the U.S. between 1910 and 1960, and women born in Norway in late 1940s and 1950s. They exploit variation in compulsory schooling laws over these periods in two countries that differ on a number of dimensions that might otherwise affect educational and fertility choices. They find that increasing the period of compulsory schooling does have the effect of reducing births to teenage girls, both in the U.S. and Norway.

This paper is similar in spirit to the work of Black et al. (2008), in that I make use of changes in education policies that affect school attendance as a means to identify effects of enrollment in school on teenage childbearing. Because states were expanding and strengthening their policies on high school exit exams, students in different grades in the same schools faced different pressures to graduate from high school. The new graduation requirements could provide an exogenous increase in the propensity to drop out of high school, and thereby offer an opportunity to identify effects of dropout on teen childbearing. The identification strategy rests on the assumption that while decisions to implement or modify exit exam policies may be driven by perceived academic needs within a state, they are not related to any changes in underlying social or economic phenomena that could affect teen childbearing. Below I discuss the context of these changes, and relation to the outcome of interest.

High School Exit Exams and Dropout

High school exit exams are a legacy of the one of the earliest reforms in what has become the accountability movement. In the early 1970s, concern that a decline in the quality of schools in the U.S. would put American business at a disadvantage in the global economy led to what has been called the "first wave" of accountability reform in public schools: minimum competency testing (Dee, 2003).[4] In late 1970s, minimum competency tests were introduced in states across the country, assessing basic skills (Peterson and West, 2003; Pipho, 1978). These tests were usually aligned to elementary or middle school levels (Jacob, 2001), and were more often used to identify low performing students for remediation than to serve as a bar above which all graduates must

[4] Concern about school quality and its long-run economic impact was central to the 1981 "A Nation at Risk" report.

pass (Dee, 2003). For example, schools modified curricula, tutored poor performing students and provided pre-tests to boost performance (Walstad, 1984), and commonly re-tested failing students (Goldman, 1984).

In the subsequent decades, high school exit exams have become more challenging, the consequences for poor performance more substantial, and more widely used. By 2008, students in 25 states were required to pass an exit exam to receive a diploma, with another planning to do so by 2012 (Center on Education Policy, 2008). Currently, exit exams affect nearly 70 percent of students in public high schools in the U.S. (Center on Education Policy, 2008). In Figure 1, I illustrate the expansion and toughening of exit exams during the last two decades. The increase appears relatively steady, beginning in the late 1990s. The real story in Figure 1, however, is that the percent of states adopting tough exit exams (aligned to high school levels), rises slowly during the early part of the panel, and then increases markedly during latter part of the period.

The impact of exit exams on student behavior and dropout has always been a contentious issue. A key criticism of has been that these exams will induce marginal students to drop out of high school, with no good alternative. The concern here is that by raising the cost of earning a high school diploma, one would expect that at the margin some students would decide that the time and effort now necessary to earn the high school degree was not an investment worth making (McDill, 1985).[5] Proponents, on the other hand, point to a number of potential benefits of exit exams on student learning and attainment. Exit exams could provide incentives for schools to improve education (Jacob,

[5] Other criticisms of exit exams include the concern that they result in "teaching to the test" or focus too much attention on the learning of marginal students at the expense of students whose academic performance is better (Airasian, 1987; Amrein and Berliner, 2002).

2001). Or, exit exams could improve learning outcomes and attainment by inducing effort and motivation on the part of students, though there is little direct empirical evidence on this.[6]

Evidence on the impact of exit exams on dropout rates has been mixed. Studies that rely on comparing students that barely pass exit exams to those that do not pass generally find no impact of failing exit exams on dropout or high school completion (Martorell, 2005; Ou, 2009; and Reardon et al., 2009).[7] However, other studies that focus on a broader margin tend to find that at least for some groups the implementation of exit exams does increase rates of dropout in the aggregate (Jacobs, 2001; Dee and Jacobs, 2007, and; Warren, Jenkins and Kulick, 2006).

There is a wide body of literature on the substantial correlation between high school dropout and risky behavior. Black et al. (2008) provide the best evidence on the direct role of policy interventions intended to affect educational attainment in shaping teenage childbearing. They examine the impact changes in compulsory schooling laws in the U.S. and Norway on teen childbearing. Black et al. (2008) exploit changes in laws that determine the age children can drop out of school (among other things) and find substantial and robust evidence that keeping children in school reduces teen pregnancy.

This paper attempts to add to what is known about the relationship between high school dropout and teenage childbearing. Rather than adopting the reduced form approach of Black et al. (2008), I examine the impact of high school dropout on teen childbearing by using the expansion of high school exit exams as an instrument for dropout. Further, I compare estimates of treatment effects estimated using the preferred

[6] Some relevant evidence comes from Roderick and Engel (2001), who find that students in the Chicago Public Schools took work more seriously following an end to social promotion in that district.
[7] An exception is Papay et al. (2010).

instrument here, with those identified using compulsory school age policies, an instrument widely used to identify causal effects of education.

Data and Approach:

Data

To examine the relationship between high school dropout and teenage childbearing, I construct a panel data set for the years 1992 to 2008. I obtain data on adolescent childbearing from vital statistics reported by all states to the U.S. Centers for Disease Control (CDC). The CDC data contain include annual information on the number of births in each state by age and race of the mother. Combined with data on population, I use these data to construct birth rates separately for girls aged 18, 17, 16, and 15. I construct birth rates for all girls in these age groups, and then separately for blacks and whites.[8]

Data on age, race and gender specific dropout rates come from the Common Core of Data (CCD) from the 1992-93 to 2007-08. The CCD is a database collected and maintained by the U.S. Department of Education's National Center for Education Statistics (NCES) that provides information on enrollment and dropout at all grades in each state. The CCD includes a number of components, but I make use of the State Aggregate Nonfiscal Data component.[9]

The NCES collects CCD data from state education agencies (SEAs), and works with these agencies to develop common reporting definitions. Working with state SEAs, the NCES developed an "event" dropout definition that is used in the CCD (Stillwell,

[8] Because of teens of other races are few very small in a number of other states, I am unable to
[9] For more information on the CCD, see http://nces.ed.gov/ccd/index.asp.

2010). The CCD definition counts a student as a dropout if he or she had been enrolled in a particular year, but on October 1 of the next academic year the student had not enrolled, graduated, or met exclusion restrictions of transferring to another school, taking temporary absence due to illness, or death (Stillwell, 2010).

There are various ways to measure dropout. Event measures like the one used here are generally preferred to status measures determined by surveying samples from general populations and inquiring about their enrollment/school completion status (Warren, 2005). Still, the CCD's measure fails to pick up subsequent re-enrollment of students who dropout in one year, only to return in a later year (Warren, 2005). However, because the CCD measure requires schools to substantiate reports of student transfer and withdraw, and it accommodates grade retention, it does not suffer from problems that have plagued studies of high school completion rate using ratios of graduates to enrollment (Warren, 2005; Dee and Jacob, 2007). For my purposes, another advantage of the CCD data is that it provides measures on grade-specific dropout rates. Since the introduction of exit exams affects some grades in a school, but not others, distinguishing between dropout rates by grade is an important aspect of identifying the impact of these tests.

To the panel, I add information on two key state policies that affect high school attendance to construct instruments for dropout. First add state level measures of the presence and grade alignment of exit exams. I obtain these measures principally from data reported by the Center for Education Progress, which conducts regular surveys of all state SEAs on exit exams. I have verified measures reported by CEP by comparing to Dee and Jacobs (2007) and have augmented some missing state/year data by contacting

state SEAs directly. Second, I add data on compulsory schooling ages in each state and year. These data have been collected by NCES intermittently since the early 1990s. I filled in data in years that these data were unavailable from NCES by collecting information directly from state education authorities, their websites, and state statutes. Finally, I add measures of employment and income from the U.S. Bureau of Economic Analysis.

Empirical Models

Using the data compiled from the CDC, the CCD and other sources, I construct a panel data set to model the birth rate to girls of a particular age, in a state in a given year. Below, *a* will index each of the 4 age groups (15, 16, 17 and 18); *s* will index state, and *t* will index year. I model birth rates as a function of a one-year lag of dropout rates in the grade in which a girl of age *a* would have been enrolled in year *t-1,* along with economic conditions as well as age, state, and year fixed-effects:

$$(1) \qquad lnB_{ast} = \beta_1 X_{st} + \beta_2 lnDropout_{a-1,s,t-1} + \mu_a + \varphi_s + \omega_t + \varepsilon_{ast}$$

where $\ln B_{ast}$ measures the log of the birth rates for girls age *a*, in state *s*, in year *t*; X_{st} is a set of controls for labor market conditions in each state and year; $\ln Dropout_{a-1,s,t-1}$ is the log of dropout rate for girls of age *a-1* in state *s* in year *t-1*.[10] The remaining terms are age, state and time-specific intercepts, respectively, along with an idiosyncratic error term pertinent for each age, state year cell. Both the distributions of pregnancy rates and dropout rates are bounded at zero and positively skewed, all models are in log-log form. The log-log specification also makes comparison of relevant effects for different age and

[10] Because the distributions of pregnancy rates is bounded at zero and positively skewed, all models are in log-linear form. The log-linear specification also makes comparison of relevant effects for different age and race group somewhat easier. In any case, the findings turn out not to be sensitive to the use of logs.

race group somewhat easier. In any case, the findings turn out not to be sensitive to the use of logs.

Model 1 identifies the effect on birth rates using variation in dropout rates within states over time for girls of various ages. The identifying assumption is that changes in dropout rates in a state are unrelated to other changes that would affect birth rates. There are a variety of potential threats to this assumption, including the possibility that declining social or institutional supports for adolescents reduce commitment to school, as well as increase the likelihood to engage in risky sexual behavior. One simple modification of Model 1 that limits this threat is to include unique age effects for each state, and state-year dummies. A model with state-specific age and year intercepts would identify effects on teen birth rates off of changes in dropout rates for a state, over and above any other within-state changes that are occurring that affect girls' propensities to give birth. This augmented model, is given as Model 2:

$$(2) \qquad lnB_{ast} = \beta_1 X_{st} + \beta_2 lnDropout_{a-1,s,t-1} + \mu_{as} + \varphi_{st} + \varepsilon_{ast}$$

where $\ln B_{ast}$, X_{st}, and $\ln Dropout_{a\text{-}1,s,t\text{-}1}$ are defined as above, and μ_{as} and ϕ_{st} are vectors of age-state, and state-year dummies, respectively. By allowing for state-specific age and year effects, Model 2 provides estimates by comparing birth rates of cohorts with different rates of dropout, netting out the usual patterns of dropout for students of the same age in the state, and the year specific change in dropout within the state that is common to all teens in the state. While this triple-difference style model is robust to threats to validity due to within state changes that affect both dropout rates and teen childbearing, its identifying assumption is that dropout rates are not affected by changes in birth rates themselves. The lag-structure of the model provides some assurance that

this assumption could hold. But, any joint determination of dropout and teen childbearing may occur in more complicated ways that are not circumvented by a one period lag. For example, combining the vagaries of academic calendars and a 40-week gestation period may mean that a student's decision to dropout in one year may be directly due to a pregnancy, that shows up as a childbirth in the next calendar year.

One strategy for dealing with the complexities introduced by a potential joint determination of dropout and childbearing is to employ an instrument for dropout that can have no direct effect on teen childbearing. A useful set of instruments would induce variation in dropout behavior that could not plausibly be driven by current or anticipated trends in adolescent fertility. The principal instruments I employ here are state level changes in high school exit exam policies. General features of high school exit exams pertinent for assessing whether these instruments meet exclusion restrictions is provided above. But, it is useful here to understand the operational variation exploited here.

The instruments used here exploit within-state differences in the introduction of exit exams and/or changes in the level at which these exams were aligned. State exit exams were implemented or made more difficult for a specific graduating class. For example, Indiana instituted an exit exam, called the Graduation Qualifying Exam and aligned to high school levels in reading and math, for the class of 2000. Students in that class knew about the requirement before they entered high school. However, students in the class of 1999 did not have to pass the exam. So, beginning in 1997, 9^{th} graders in Indiana faced the prospect of a high school aligned exit exam, while students in 10^{th} grade and above did not. The next year (1998), 9^{th} and 10^{th} graders faced the GQE as a condition of graduation, 11^{th} and 12^{th} graders did not. And, so on. It is this within-state

variation in exposure of students of different ages to exam requirements, and hence to a pressures that directly affect dropout, that establish the instrument I employ in a 2SLS framework to estimate causal effects of dropout on adolescent childbearing.

Results

Descriptives:

In Table 1, I present descriptive statistics for the analytical sample. There are a total of 3,060 age-state-year cells in the panel.[11] Overall birth rates to adolescent girls were 21.48 per 1,000.[12] Birth rates rise quickly with age: Rising from 11.07 per 1,000 for 15 year olds to 64.48 per 1,000 for 18 year olds. Similarly, dropout rates rise with age: From just under 4 percent to near 6 percent between the 9th and 12th grades. About a third (0.352) of those grades was required to pass some form of exit exam for graduation. About one in six (0.154) of the grades were required to pass the more challenging exit exams aligned at the high school level. During the period, annual dropout rates were between 3.98 and 5.77 percent, rising a bit with grade.

As a first step to understanding the overall variation in the key variables of interest, consider the time series in Figure 2. Figure 2 presents population weighted time series of teen birth rates for 15 year olds from the early 1990s through the late 2000s.[13] The time series make clear that dropout rates were falling, substantially during the period, from just over 6 percent of students dropping annually in the early 1990s, to about 4 percent by 2005, and then rose a bit after that. It appears that the decline was not even, remaining at around 6 percent until 1997, and then falling. At the same time, teen birth

[11] Data are missing on birth rates to various age groups in various states, years in just over 300 cases. I limit my analysis to the 3,060 cases with reported fertility data.
[12] This rate includes girls under the age of 15.
[13] Focusing on the series of teen births for one age group simplifies the graph. The patterns for all other age groups are the same as the time series in Figure 2, though as Table 1 makes clear, they differ in level.

rates were falling, from about 16 per 1,000 to about 9 per 1,000 over this period. Two features of these time series are worth noting: They trend in the same direction, and the periods of slowest/fastest change overlap. So, the middle parts of both decades saw relatively small changes in dropout and pregnancy, while both fell sharply in the period between. Of course, these simple time series are nothing more than suggestive.

Main Findings:

In Table 2, I present estimates of the models of the relationship between dropout rates and teen birth rates. In the first set of columns, I present results of Model 1, described above, for all girls, and then separately by race. In the next set of columns I present the results of Model 2, which improves on the differences-in-differences set up from Model 1, to estimate changes in birth rates to teen girls by comparing changes within age-groups within states to limit threats to identification that would occur if changing cohort quality were associated with changing dropout rates. Again, these results are presented first for all girls, then separately by race. In the final set, of columns I present results from a model that augments the differences-in-differences-in-differences estimate from Model 2 by using an instrumental variables approach, where the instruments are measures of state exit exam policies.

The results from Model 1 suggest that high school dropout has a significant effect on teen birth rates, overall, and for both black and white girls separately. For all groups, a percent increase in dropout rates is associated with between a 0.04 and 0.06 percent increase in birth rates. The results from Model 2 look somewhat similar to those of Model 1 overall, and for black girls. For white girls, however, I estimate a somewhat larger response in birth rates to dropout.

While the first two models provide some evidence of small impacts of dropout on teen births, both require strong assumptions if they are to be interpreted as causal. Recall that the identifying assumption for Model 1 is that changes in dropout rates within states are not related to any underlying state characteristics that might be associated with supports for teens, or other state characteristics associated with teen birth rates. Model 2 relaxes this assumption by allowing changes in dropout rates to be correlated with unmeasured factors that affect birth rates, but could still confound effects with changes in state environments that affect birth rates.

The results in Model 3 combine the features of the panel strategy in Model 2 with an instrumental variables approach. The instruments are a series of binary variables to indicate whether or not a teen of age *a* in state *s* in year *t* would have been: 1) Required to take an exit exam; 2) Required to take an exit exam aligned at the high school level, and 3) Had the opportunity to earn a high school credential through an alternative pathway if a student failed the high school exit exam. The three variables measure the exposure of age/state/year cohorts to exit exams, as well as two key features these exams.

The results from the IV estimates are uniformly larger in magnitude. Overall, I estimate the dropout elasticity of teen birth rates to be 0.15, about three times larger than the ordinary estimates. The most striking difference between the estimates in Model 3, and those in the two earlier models can be seen for black girls. The IV estimate is that a 1 percent increase in dropout rates for black girls is associated with a 0.256 percent increase in birth rates. That the causal effect of dropout on birth rate might be larger for black girls than other groups may be due to relatively poor employment conditions for black teens: Who upon dropping out find fewer opportunities in the labor market and

hence a lower opportunity cost for childbearing. Or, it could be due to a phenomenon discussed by sociologists suggesting teenage childbearing within some black communities serves and an alternative life-course strategy that is a response to social and economic disadvantage (Burton, 1990).

While the instruments pass the usual tests, they are not highly predictive in the first stage. I report the F-statistic on the test of joint significance at the bottom of the panel for Model 3. In all cases, the F-statistics are significant, but they are not especially large. In part this could be because there is little variation left in dropout when all the time, age, and state effects are included in a model like the one used here. Nonetheless, it is clear the instruments are not especially powerful predictors of first-stage dropout rates.

Alternative Instruments and Local Treatment Effects:

While the instruments first-stage predictive power is not ideal, they pass standard tests of significance and provide credible evidence on the relationship between high school dropout and teen pregnancy. Estimating the relationship between dropout and pregnancy is fraught with hazards, because both outcomes are likely affected by complicated and difficult to control factors. In this context, IV strategies can provide evidence on pregnancy through variation in plausibly exogenous variation in dropout rates. However, the insights provided by IV are typically limited to treatment margins that are not clearly generalizable to all treatment eligibles. Hence, local average treatment effects (LATE) identified from one margin may not be informative of relevant population average treatment effects (PATE) for a variety of policy interventions (Angrist and Imbens, 1994; Angrist, 2004; Heckman and Vyclatil, 2000).

One way to circumvent this limitation is to identify instruments affect a large and potentially more representative portion of the population eligible for treatment. For example, Oreopoulus (2006) and Ebenstein (2009) provide evidence from empirical settings which offer clearer comparisons of LATE and PATE estimates because of natural experiments which induced change in relatively large portions of the treatment eligibles. An alternative strategy is to identify various instruments for the same endogenous regressor that affect different treatment margins.

For this purpose in this case, an alternative set of instruments is clearly suggested by previous work. Perhaps the most widely used set of instruments in the literature examining education effects on labor market and other outcomes are measures of state compulsory education policies.[14] Further, the only previous work on the topic of the current paper used compulsory schooling laws in a reduced form framework. Black et al. (2008) find that in both the U.S. and Norway, changing compulsory schooling laws to keep students in school longer has the additional effect of reducing rates of teen pregnancy.

In Table 3, I report the results of models in which I use compulsory schooling laws and their changes as instruments for high school dropout as a means to identify effects on pregnancy through a different margin than the one operating in Table 2. The results in the first panel of Table 3 can be directly compared to the results in the third panel of Table 2. Comparing the estimates of the dropout effect on teen births between the models results in interesting and sometimes contradictory conclusions. First, IV models exploiting compulsory school-age policies suggest there is no relationship between dropout and teen pregnancy for all girls. Yet, the same models find significant

[14] The seminal work in this area was Angrist and Krueger, 1991.

and substantial impacts of dropout on pregnancy for black girls and white girls, separately. There are two factors at play behind this paradox. First, black and white are not exhaustive, so the "all girls" category includes Hispanics, Asians, and aboriginals, for whom behavioral responses may be different. Second, and more importantly, the impacts of education policy changes on dropout behavior have been found to be quite different for black and white students in other contexts (e.g. Marcotte, 2010). Hence, there is some advantage to models that permit compulsory schooling laws to have different effects in the first stage.

More importantly, the results in Table 3 make clear that the effects of high school dropout on teen pregnancy for black and white girls are nearly identical to those identified in Table 2. That estimates identified off of changes in compulsory schooling laws and those that exploit variation in exit exam policies generate nearly identical results provides evidence against the concern that heterogeneous treatment effects limit the conclusions that can be reached from research designs that exploit variation at either margin.

In the second panel of Table 3, I combine both sets of instruments and re-estimate dropout effects on pregnancy rates. The results in Table 3 are weighted averages of local treatment effects identified at margins affected by exit exams, and compulsory schooling laws. Consequently, the results are nearly identical to previous results for black and white girls, separately. The results for all girls are similar to the estimates obtained using state exit exam policies only as instruments, likely due to the fact that these instruments performed better in the first stage than did the instruments derived from compulsory school policies.

Conclusions

In this paper I have attempted to provide insight into the effect of early education problems on teen childbearing. I have argued that the relevance of this question rests on the large costs to families and society. The results here are important to understanding these impacts for at least two reasons. First, variation over time in exam policies in the U.S. provides a natural experiment that offers a credible mechanism through which to identify causal effects of dropout on teen pregnancy. A second lesson is that the causal effects are nearly identical when identified using different IV strategies, and different treatment margins.

The findings suggest that the dropout elasticity of pregnancy is 0.13 for white teens and 0.25 for black teens. To help interpret the magnitude of these effects, it is useful to recall the time series in Figure 2. Over the period under study here, dropout rates fell by about a third, from nearly 6 percent to about 4 percent. The estimates here suggest that this decline would reduce teen pregnancy by about 4 percent for whites and 8 percent for blacks. Birth rates for white teens over this period fell from about 50 per 1,000, to 40 per 1,000. Birth rates for black teens fell from about 90 to 50 per 1,000 over the same period. The result from the IV models in Tables 2 and 3 imply that the decline in dropout could account for a about a fifth of the decline in white teen births (2 per 1,000), and just under a fifth of the decline in black teen births (7 per 1,000). Clearly, these are substantial impacts. The mechanisms for these impacts cannot be known here. One possibility is that this entirely an incarceration effect. Alternative interpretations include the possibilities that additional education raises the opportunity cost of childbirth to teens or improves allocative efficiency.

Finally, the results of the current paper are important to a broader set of papers that employ changes in compulsory schooling to identify education effects. As has been the case in other studies in the United States, I find that use changes in compulsory schooling laws are relatively weak instruments. Nonetheless, I find that the treatment effects identified using compulsory schooling laws are quite similar to those identified using state high school exit exam policies. This finding limits concerns that treatment effects identified at either margin are uninformative about more general responses to increased educational attainment on teen fertility.

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Figure 1

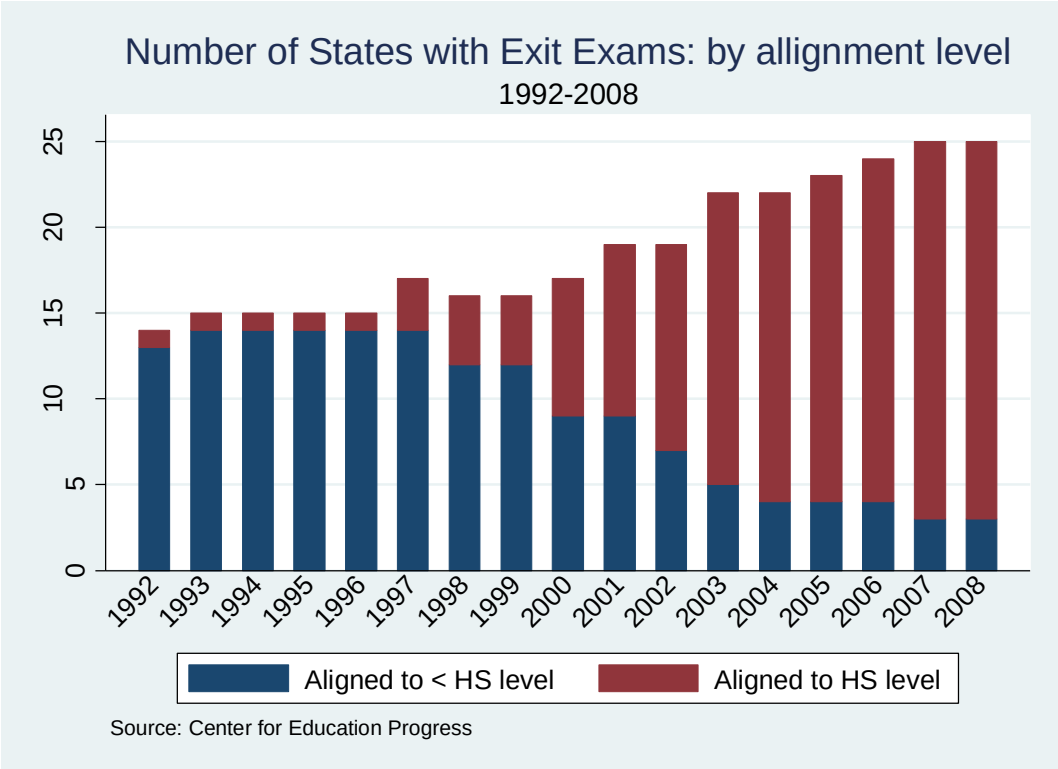

Figure 2

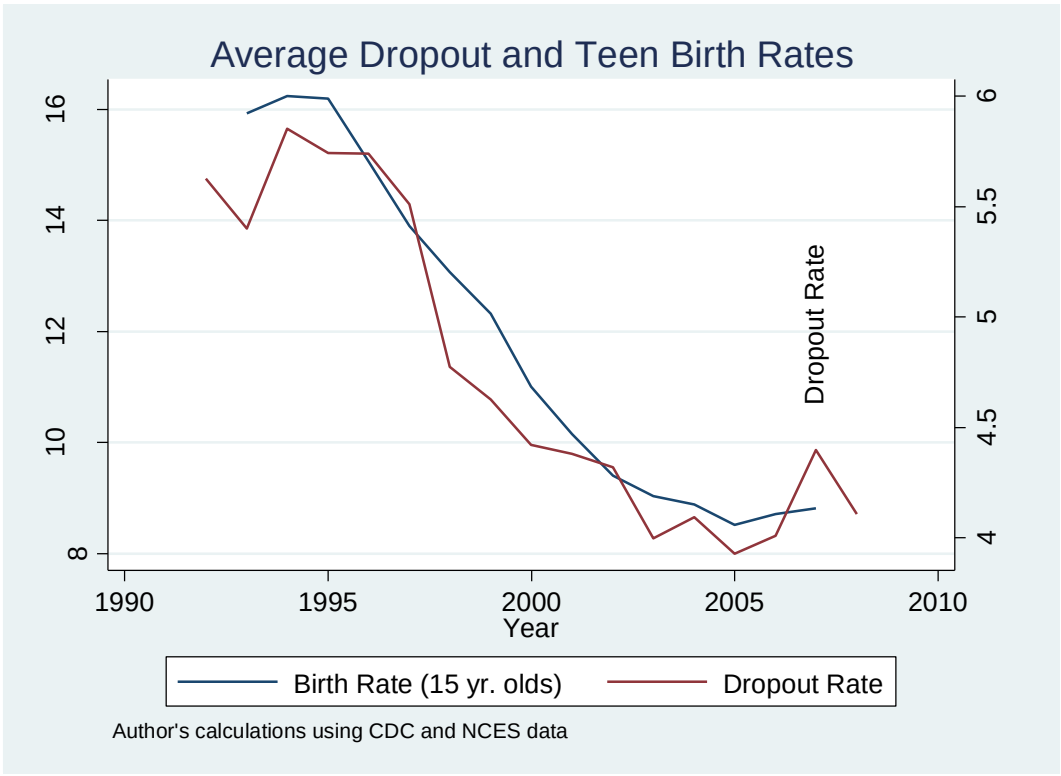

Table 1 Descriptive Statistics

Variable	Mean	Standard Deviation
Employment (100,000s)	3.19	3.42
Per Capita Income	28,538.6	7,636.68
Population (millions)	5.51	6.13
Exit Exam (0/1)	0.352	0.469
HS Aligned Exiit Exam (0/1)	0.154	0.305
9th grade - dropout rate	3.98	2.22
10th grade - dropout rate	4.86	2.22
11th grade - dropout rate	5.26	2.02
12th grade - dropout rate	5.77	3.23
Birth Rate 15 yrs old	11.07	6.56
Birth Rate 16 yrs old	24.60	12.18
Birth Rate 17 yrs old	42.31	15.11
Birth Rate 18 yrs old	64.48	19.10
Birth Rate all	21.48	8.17

n = 2,500

Note: all birth rates per 1,000

Table 2

Estimates of the Relationship Between High School Dropout and Teen Birth Rates

	Model 1: D-D			Model 2: D-D-D			Model 3: IV-DDD		
	All Girls	Black Girls	White Girls	All Girls	Black Girls	White Girls	All Girls	Black Girls	White Girls
High School Dropout Rate	0.054	0.059	0.039	0.054	0.048	0.158	0.151	0.256	0.134
	0.014	*0.02*	*0.016*	*0.026*	*0.041*	*0.029*	*0.044*	*0.056*	*0.04*
Income (in 1,000s)	-0.018	-0.015	-0.019	-0.02	-0.03	-0.059	-0.024	-0.034	-0.026
	0.005	*0.006*	*0.0005*	*0.007*	*0.0023*	*0.009*	*0.002*	*0.002*	*0.002*
Employment (in 100,000s)	-0.005	0.007	-0.005	-0.0001	-0.005	0.109	-0.001	0.01	-0.003
	0.003	*0.006*	*0.003*	*0.005*	*0.015*	*0.015*	*0.003*	*0.007*	*0.004*
State Population (in 100,000s)	0.0002	-0.006	0.009	-0.007	0.005	-0.059	-0.004	-0.007	0.009
	0.003	*0.005*	*0.002*	*0.005*	*0.01*	*0.009*	*0.003*	*0.006*	*0.0028*
Include state-specific year effects?	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Include state-specific age effects?	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
F-test on instruments in 1st stage							1.8	6.96	2.49
							(p=0.08)	(p=0.00)	(p=0.01)
R^2	0.981	0.962	0.986	0.993	0.979	0.996	0.98	0.957	0.987
N	2500	2251	2304	2500	2251	2304	2500	2151	2304

Standard errors in italics

All models include state, age, and year fixed effects

Table 3

Alternate IV Estimates of the Relationship Between High School Dropout and Teen Birth Rates

	Model 3: IV-DDD Instruments: Compulsory Schooling Laws			Model 3: IV-DDD Instruments: Compulsory Schooling Laws & Exit Exams		
	All Girls	Black Girls	White Girls	All Girls	Black Girls	White Girls
High School Dropout Rate	0.018	0.23	0.124	0.153	0.256	0.134
	0.045	*0.057*	*0.04*	*0.044*	*0.056*	*0.04*
Income (in 1,000s)	-0.045	-0.034	-0.026	-0.024	-0.034	-0.026
	0.004	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*
Employment (in 100,000s)	-0.004	0.01	-0.002	-0.001	0.01	-0.003
	0.003	*0.007*	*0.004*	*0.003*	*0.007*	*0.004*
State Population (in 100,000s)	-0.001	-0.008	0.008	-0.004	-0.007	0.009
	0.003	*0.006*	*0.0028*	*0.003*	*0.006*	*0.0028*
Include state-specific year effects?	Yes	Yes	Yes	Yes	Yes	Yes
Include state-specific age effects?	Yes	Yes	Yes	Yes	Yes	Yes
F-test on instruments in 1st stage	0.95	2.97	1.18	1.7	5.23	2.27
	(p=0.48)	(p=0.004)	(p=0.31)	(p=0.05)	(p=0.00)	(p=0.005)
R^2	0.984	0.96	0.987	0.98	0.959	0.987
N	2390	2051	2200	2390	2051	2304

Standard errors in italics

All models include state, age, and year fixed effects