The Relationship Between Academic Achievement And Nonmarital Teenage Childbearing: Evidence from the Panel Study of Income Dynamics

By Cary Lou and Adam Thomas

Cary Lou is senior analyst, Center on Education and the Workforce, McCourt School of Public Policy, Georgetown University, Washington, DC. Adam Thomas is research fellow, Child Trends, Washington, DC; and visiting associate professor, McCourt School of Public Policy, Georgetown University.

CONTEXT: *Females who do well in school are less likely than those who do poorly to experience a nonmarital teenage birth. However, little is known about which dimensions of academic achievement are the most strongly related to teenage childbearing, or about whether the relationship between achievement and childbearing varies according to the presence of other behavioral problems.*

METHODS: *Individual-level and family-level data from the Panel Study of Income Dynamics, combined with information on contextual state-level economic and policy measures, were used to study nonmarital childbearing between the ages of 16 and 19 among 701 females who turned 16 between 2000 and 2007. Multivariate logistic regression analyses examined the relationship between the probability of nonmarital teenage childbearing and age-standardized scores on academic assessments of letter-word identification, passage comprehension and applied problem-solving ability.*

RESULTS: *Scores on the passage comprehension and applied problem-solving subtests were strongly associated with the probability of experiencing a nonmarital teenage birth among respondents who had relatively few behavioral problems. For this group, an increase of one standard deviation in the score on either assessment was associated with a reduction of about 50% in the risk of experiencing a nonmarital teenage birth. However, no evidence was found of an equivalent relationship among respondents with more pronounced behavioral problems or for the letter-word identification assessment.*

CONCLUSIONS: *Future research should continue to explore the possibility that improvements in academic achievement may help to reduce the rate of nonmarital teenage childbearing.*

Perspectives on Sexual and Reproductive Health, 2015, 47(2):91–98, doi:10.1363/47e2115

The teenage birthrate in the United States has fallen by more than half over the past two decades, and the 2013 rate of 27 births per 1,000 females aged 15–19 is a historic low.[1] Even after this decline, however, nearly 300,000 children are born to teenage mothers annually,[1] and teenage births remain much more common in the United States than in other developed countries.[2]

Teenage childbearing is associated with a variety of negative outcomes for those who are directly involved and for society more broadly. For example, the children of teenage mothers are disproportionately likely to experience chronic health problems early in life[3] and to be incarcerated later in life.[4] They also tend to have poorer cognitive outcomes than children whose mothers gave birth in their early 20s.[5] From the mother's perspective, teenage childbearing is related to diminished educational attainment[6] and earnings,[7] and to an increased risk of living in poverty.[8] On a societal level, recent estimates suggest that teenage childbearing costs U.S. taxpayers nearly $10 billion per year in government expenditures on health care, public assistance, the criminal justice system and other services.[9] Many studies have found that the estimated economic effects of teenage childbearing are smaller, but are still negative, when they take into account the fact that many young women who have a child were disadvantaged prior to giving birth.[10–12]

In part because of the presumed costs associated with teenage childbearing, there is a substantial literature examining the root causes of this phenomenon. Studies have shown that teenage birthrates are negatively related to certain measures of economic opportunity, including intergenerational income mobility,[13] employment rates[14] and adolescents' educational expectations.[15] Among disadvantaged young women, the probability of experiencing a nonmarital birth has been found to be positively associated with the level of income inequality in the states where they are living.[16] In addition, tuition levels at two-year colleges in teenagers' states of residence have been shown to be positively related to their number of sexual partners,[17] which suggests that youth who face lower costs of postsecondary education may be relatively less likely to engage in risky sexual behavior. Collectively, this research suggests that the economic cost of teenage parenthood may be an important determinant of early childbearing.

In keeping with this hypothesis, a handful of studies have found evidence of a negative relationship between various measures of academic success and the probability of experiencing a teenage birth. Two analyses of the 1979 panel of the National Longitudinal Survey of Youth showed that the probability of becoming a teenage mother was negatively related to combined standardized test measures of numeracy

and literacy,[18,19] and an analysis of data from the National Education Longitudinal Study of 1998 found that females who dropped out of school were more likely than others to experience a school-age birth.[20] Another study showed that females who were randomly paired with higher quality teachers (in terms of the test scores achieved by those teachers' students) were less likely to experience a teenage birth than were students paired with lower quality teachers.[21]

Like these earlier studies, ours examines the relationship between students' academic achievement and their subsequent likelihood of giving birth as teenagers. However, we make three novel contributions to the existing literature. First, rather than relying on a single measure of scholastic success, we assess the relationship between teenage childbearing and several different dimensions of academic achievement. Second, unlike past treatments of this topic, ours addresses the question of whether the relationship between teenage childbearing and academic achievement varies according to the extent of respondents' behavioral problems. And third, we use the longitudinal Panel Study of Income Dynamics (PSID) data set to control for numerous aspects of respondents' personal and family backgrounds that are plausibly relevant to, but are not generally included in, such analyses. We also account for several potentially confounding societal factors as measured at the state level.

METHODS

Data

The PSID is a longitudinal survey administered by the Institute for Social Research at the University of Michigan. The survey began in 1968 with a national sample of 4,802 families comprising 18,230 individuals.[22] Households were surveyed annually until 1997; since that time, they have been surveyed biennially. We constructed our analytic sample using data from the main interview and from PSID's Child Development Supplement (CDS) and Transition into Adulthood surveys.

The CDS was started in 1997 and surveyed a random, nationally representative sample of 3,563 children aged 12 or younger from 2,380 PSID households.[23] Information was gathered from the child and from his or her caregivers (parents or others), absent parents, teachers and school administrators regarding the child's time use, home environment, perceptions and attitudes, and physical and cognitive development. Follow-up surveys were administered in 2002 and 2007 for the same group of children if they were still younger than 18 and living at home.

Transition into Adulthood surveys have been conducted biennially since 2005. The most recent year for which data from this survey are currently available is 2011. These surveys track CDS respondents from age 18 until they form their own households and join the main PSID sample, or until they reach the age of 26, whichever comes first.[24] The questions asked in these surveys expand on questions in the CDS.

We combined information from these three PSID data sets with state-level data on unemployment rates and various public policies that have been found to be related to teenage childbearing in previous research.

Dependent Variable

Nearly 90% of teenage births occur out of wedlock,[1] and single parenthood has been found to be associated with a host of negative child and family outcomes.[25–29] We therefore focused specifically on nonmarital teenage births, and our dependent variable is a dichotomous measure of unwed teenage childbearing. Data for this variable were taken from the Transition to Adulthood and main PSID surveys, in which respondents were asked at what age they had their first child and at what age they were first married.* A nonmarital teenage birth was defined as a first birth to a woman aged 16–19 who had never been married. We therefore limited our analysis to women who were at least 20 at the time of their last interview. To avoid overlap between the time periods during which test scores and births were measured, we did not use data on childbearing among respondents younger than 16.

Key Independent Variables

For our main independent variable, academic achievement, we used CDS respondents' scores on Woodcock Johnson–Revised assessments of letter-word identification, passage comprehension and applied problem-solving skills. These scores constitute the primary measures of academic skills in the PSID,[30] and they were chosen from among the range of Woodcock Johnson assessments because they were the only ones included in all three rounds of the CDS.[31] Test score data were extracted for females who were aged 6–14 at the time of assessment. The letter-word subtest measures the respondent's ability to identify letters and words and to match words with pictures; the passage comprehension subtest assesses reading comprehension skills; and the problem-solving subtest measures the ability to solve practical problems mathematically.[23] Scores on each assessment were standardized by age to have a mean of 100 and a standard deviation of 15 for the overall population. Because a birth at age 16 could be the result of a pregnancy that occurred at age 15, we used data only from assessments completed before age 15. This restriction ensures that pregnancies do not affect test scores. In some regression models, we entered respondents' scores for each subtest separately; in other models, we simply included a composite (average) score for the three assessments.

It is possible that the relationship between academic success and teenage pregnancy varies according to other behavioral attributes. More specifically, this relationship could be moderated by the degree to which students are predisposed to risky behavior. In most analyses, we therefore interacted our score variables with respondents' Behavior Problems

*We would also prefer to have examined the relationship between academic achievement and the probability of having an abortion as a teenager. However, because PSID respondents were not asked about the timing of terminated pregnancies, we were unable to determine whether their past abortions (if any) occurred when they were teenagers.

Index scores. The PSID's behavior problems scale was created using responses provided by the primary caregiver to a series of questions about the respondent's behavioral traits—secretiveness, depression, disobedience, impulsiveness and social attachment to other children who get into trouble.[23] Higher scores on this scale reflect larger numbers of behavioral problems.

Control Variables

Our multivariate analyses controlled for a rich set of individual and family characteristics and state-level variables that are plausibly related to both academic achievement and teenage childbearing. Information on respondents' characteristics was taken from the CDS and main PSID interview files. Most covariates were recorded either at the time of the respondent's birth or in the survey year in which she turned 13 or 14.

Previous studies have shown that the probability of experiencing a teenage birth is negatively related to family-level variables such as maternal educational attainment[32–34] and maternal marital status,[33,34] and is positively related to household poverty status[33] and being born to a young mother.[33,35] We therefore controlled for a number of characteristics of the respondent's caregiver. For most respondents, the primary caregiver was their biological mother. In a minority of cases, the primary caregiver was their biological father, adoptive parent or stepparent, or another family member. For some of our parental measures, we used data on the individual who was designated as the respondent's primary caregiver in the 1997 CDS survey. For variables that refer specifically to the mother's characteristics when the respondent was born, we used information on the biological mother, regardless of whether she was designated as the primary caregiver. More specifically, we controlled for the primary caregiver's raw passage comprehension score* and years of education, whether the respondent's mother was married when the respondent was born, whether the respondent's mother was a teenager when the respondent was born, and family income (expressed in 2012 dollars).

We also controlled for whether the respondent was low-birth-weight, because this variable is correlated with indicators of background disadvantage such as low family income and household poverty.[36–38] Given that teenage childbearing patterns vary by race and ethnicity[39] and by religiosity,[32,40,41] we included in our regressions a series of dummy variables reflecting the respondent's race or ethnicity and the frequency with which she attended religious services. In addition, we controlled for general trends in teenage childbearing during our period of study by including dummy variables that account for the year in which the respondent was born. Furthermore, because there was variation in the age at which respondents completed the academic tests included in our analyses, we controlled for the respondent's age at assessment.

We additionally controlled for a variety of state-level measures that have been included in other analyses of teenage childbearing.[16,33,42] The teenage birthrate has been found to be positively related to state-level cash-assistance benefits[34] and unemployment rates,[14] and to be negatively related to state laws restricting abortion funding and access,[34,43] as well as to state policies expanding access to contraception.[34,42,44] We therefore included controls for the annual unemployment rate in the respondent's state of residence;[45] for the maximum monthly Temporary Assistance for Needy Families (TANF) benefit (expressed in 2012 dollars) for a family of three with no income;[46–48] and for whether a state implemented a TANF family cap,[46] a duration-based waiver to expand access to Medicaid family planning services and an income-based waiver to expand such services.[49] Finally, we controlled for whether a respondent's state had a restriction on Medicaid funding for abortion, an abortion restriction involving parental involvement and a mandatory waiting period for abortions.[50]

Because a substantial proportion of the geographic variation in teenage birthrates can be explained by fixed differences in state-level cultural and economic characteristics,[33] our models also included a set of state fixed effects dummy variables that record the respondent's state of residence during the survey year when she turned 13 or 14. These state dummies control for heterogeneity in our data that is a function of the time-invariant characteristics of the states where respondents were living shortly before they entered the risk period during which we measure childbearing. We were able to control for both state fixed effects and time-varying state-level characteristics because the state of residence was not measured in the same year for all sample members.

About 2% of the values for our control variables were missing. Wherever possible, these values were filled in using linear interpolation techniques; in cases where interpolation was either inappropriate or not possible, single imputation was used to fill in missing values as a function of the respondent's other characteristics.

Analysis

Of the 1,750 female participants in the CDS, 658 were excluded because they were not yet 20 years old at their most recent interview, 19 were excluded because they experienced a birth prior to age 16 and 372 were eliminated because they had missing values for one or more variables included in our analysis (even after we performed our interpolation and imputation procedures). Our final analytic sample included 701 females. These respondents represented nearly two-thirds of women who had reached age 20 as of 2011, the most recent year for which data are available.† Given our sample restrictions, the empirical

*The PSID does not collect information on the primary caregiver's scores on any other subtests.

†The results of exploratory analyses indicate that relative to the individuals in our analytic sample, CDS respondents who were dropped either because of an early teenage birth or because of missing data were more likely to have been born to a teenage mother, were more likely to have been born to an unmarried mother, were less likely to be white and had lower average family incomes.

TABLE 1. Selected characteristics of female respondents to the Child Development Supplement and the Transition into Adulthood surveys, Panel Study of Income Dynamics, 1997–2011, and selected characteristics of their states of residence, by whether women had a nonmarital teenage birth

Characteristic	Nonmarital teenage birth (N=117)	No nonmarital teenage birth (N=584)
INDIVIDUAL LEVEL		
Mean academic test scores		
Composite***	98.4	107.8
Letter-word**	99.8	109.5
Passage comprehension***	97.4	106.8
Applied problem-solving***	98.1	107.3
Respondent and family		
Mean Behavior Problems Index score***	10.6	7.6
Primary caregiver's mean passage comprehension score***	27.9	32.2
Born to unmarried mother***	47.9	18.2
Born to teenage mother***	28.2	5.3
Primary caregiver's mean no. of years of education***	11.4	13.2
Mean family income (in 2012 $)***	47,254	112,257
Low-birth-weight	9.4	5.7
Race/ethnicity		
White***	41.6	75.1
Black***	38.6	12.4
Hispanic	9.4	6.5
Other	10.4	6.1
Attendance at religious services		
Several times a week*	6.8	13.7
Once a week	19.5	25.9
A few times a month	8.1	10.3
Once a month	10.2	4.2
<once a month	9.8	15.4
Never*	45.6	30.4
Mean age at assessment†	11.5	11.9
STATE LEVEL		
Annual unemployment rate	5.0	5.1
TANF		
Mean maximum monthly benefit (in 2012 $)**,‡	455	548
Family cap	47.0	48.7
Medicaid family planning waiver		
Duration-based	15.8	15.5
Income-based	25.9	27.9
Abortion restrictions		
Medicaid funding**	79.7	60.8
Parental involvement†	74.3	59.4
Mandatory delay	45.3	34.7

*p<.05. **p<.01. ***p<.001. †p<.10. ‡For a family of three with no income. *Notes:* Academic test scores reflect performance on Woodcock Johnson–Revised assessments; scores for teenagers are age-standardized, while scores for caregivers are not. Data are expressed as percentages unless otherwise indicated. Percentages for some categorical variables may not sum to 100.0 because of rounding. TANF=Temporary Assistance for Needy Families. *Sources:* All individual-level data are from the Panel Study of Income Dynamics. **Unemployment rates**—reference 45. **TANF data**—references 46–48. **Medicaid waivers**—reference 49. **Abortion restrictions**—reference 50.

analyses account for births that occurred to members of the original CDS sample between 2001 (the earliest survey year in which they could have reached 16 years of age) and 2011. All results were adjusted using an individual demographic weight variable contained in the original 1997 CDS file. Unweighted regression results were similar to the weighted results reported here.

Since our dependent variable is dichotomous, we used logistic regression analysis to model respondents' probability of experiencing a teenage birth. Because the estimates produced by logistic models are expressed in units of logged odds, they cannot be interpreted as the change in the probability of teenage childbearing that accompanies a one-unit change in the relevant independent variable. We therefore also report average marginal effect estimates for our test-score variables. To produce these estimates, first we calculated the change in the predicted probability of experiencing a nonmarital teenage birth that is associated with a one-unit change in test scores for each respondent, holding all covariates constant at their observed levels. Then, we calculated the average of this change across sample members.

RESULTS

Descriptive Statistics

About 10% of females in our weighted sample (which corresponds with 117 of the 701 respondents in the unweighted sample) experienced a nonmarital first birth between the ages of 16 and 19. Compared with females who did not have a teenage birth out of wedlock, females who did experience a teenage birth had significantly lower scores on each academic subtest and on the composite measure (Table 1). Females in the latter group also had higher behavior problems scores, on average—in other words, they had larger numbers of behavioral problems. Respondents who had had a nonmarital teenage birth were also disproportionately likely to be disadvantaged on most other dimensions. For example, the test scores and educational attainment of respondents' primary caregivers were lower for those who had experienced teenage childbirth than for those who had not. Moreover, members of the former group had lower family incomes and were disproportionately likely to have been born out of wedlock. They were also more likely to have been born to a teenage mother. In addition, respondents who experienced a teenage birth were more likely than those who did not to be black and were less likely to be white. They were also less likely than their counterparts to attend religious services several times a week and were more likely never to attend services. Finally, state TANF benefits were lower, and the likelihood of state restrictions on Medicaid funding for abortion was greater, for females who had a nonmarital teenage birth than for other respondents.*

Regression Analyses

The results of a simple bivariate regression analysis confirmed the existence of a negative and statistically significant correlation between the composite academic score and the probability of experiencing a nonmarital teenage birth (Table 2). The average marginal effect estimate for

*The descriptive results for some of our state-level controls might be interpreted as contradicting the literature described earlier, which showed that teenage birthrates are positively related to TANF benefit levels and negatively related to restrictive abortion policies. However, the coefficients for these variables were rarely statistically significant in our regression models. Moreover, most earlier work analyzed panel data, which permits assessments of variation within states over time and arguably accommodates the estimation of causal effects. Our descriptive results reflect simple cross-sectional differences in the characteristics of the states in which our sample members lived at age 13 or 14.

TABLE 2. Logged odds from logistic regression analyses assessing associations between selected characteristics and the probability of nonmarital teenage childbearing, and average marginal effects associated with composite test scores

Characteristic	Model 1	Model 2	Model 3
INDIVIDUAL LEVEL			
Composite test score	–0.047 (0.011)***	–0.008 (0.012)	–0.055 (0.030)†
Behavior Problems Index (BPI)			
BPI score		0.048 (0.027)†	–0.394 (0.236)†
BPI score x composite test score			0.005 (0.002)†
Respondent and family			
Primary caregiver's passage comprehension score		–0.105 (0.042)*	–0.094 (0.042)*
Born to unmarried mother		–0.025 (0.464)	–0.092 (0.456)
Born to teenage mother		1.466 (0.493)**	1.460 (0.493)**
Primary caregiver's no. of years of education		–0.003 (0.081)	–0.005 (0.080)
Family income (in tens of 000s of 2012 $)		–0.117 (0.044)**	–0.118 (0.046)*
Low-birth-weight		–0.213 (0.684)	–0.270 (0.693)
Race/ethnicity			
White (ref)		na	na
Black		1.602 (0.500)***	1.825 (0.520)***
Hispanic		1.029 (1.057)	1.105 (1.098)
Other		0.914 (0.715)	1.104 (0.713)
Attendance at religious services			
Several times a week (ref)		na	na
Once a week		1.536 (0.621)*	1.571 (0.641)*
Few times a month		0.986 (0.735)	0.934 (0.741)
Once a month		2.419 (0.751)***	2.510 (0.778)***
<once a month		0.537 (0.709)	0.554 (0.709)
Never		1.215 (0.620)†	1.242 (0.630)*
Age at assessment		–0.214 (0.111)†	–0.218 (0.103)*
STATE LEVEL			
Annual unemployment rate		–0.082 (0.284)	–0.191 (0.295)
TANF			
Maximum monthly benefit (in 2012 $)‡		–0.007 (0.005)	–0.008 (0.005)
Family cap		–1.203 (0.904)	–1.463 (0.925)
Medicaid family planning waiver			
Duration-based		0.807 (1.068)	0.559 (1.118)
Income-based		–0.213 (0.923)	0.015 (0.886)
Abortion restrictions			
Medicaid funding		–1.607 (1.535)	–1.750 (1.587)
Parental involvement		–1.646 (1.153)	–1.906 (1.219)
Mandatory delay		1.013 (0.823)	1.439 (0.814)†
Constant	*2.643 (1.102)**	*7.946 (5.199)*	*13.271 (5.775)**
ESTIMATED AVERAGE MARGINAL EFFECTS			
All women	–0.004 (0.001)***	–0.001 (0.001)	
Women with high BPI scores			0.001 (0.001)
Women with low BPI scores			–0.002 (0.001)†
Chi-square for joint hypothesis tests§			*3.74*
Pseudo R^2	*0.060*	*0.378*	*0.388*

*p<.05. **p<.01. ***p<.001. †p<.10. ‡For a family of three with no income. §The null hypothesis is that the coefficients for the composite test score and Behavior Problems Index score interaction term equal 0. *Notes:* Models 2 and 3 include a full set of state and birth-year fixed effects dummy variables. Figures in parentheses are heteroskedasticity-consistent standard errors. ref=reference group. na=not applicable. TANF=Temporary Assistance for Needy Families.

model 1 showed that a one-point increase in test scores was associated with a decrease of 0.4 percentage points in the probability of teenage childbearing. This relationship was large in magnitude, given that the standard deviation for composite scores in our overall analytic sample was about 15 points (i.e., a one-point change in test scores equated to a movement of only about one-fifteenth of a standard deviation, or approximately 0.07 standard deviations), and since only about 10% of respondents in our sample experienced a nonmarital teenage birth. The estimate produced by this model, however, was likely affected by the exclusion of numerous factors related to teenage childbearing and test scores.

The addition of control variables to the regression captured a substantial amount of the heterogeneity in the sample, increasing the pseudo R^2 by more than 30 points. Much of this additional explanatory power was provided by the controls for individual and family characteristics.

TABLE 3. Logged odds from logistic regression analyses assessing associations between academic and behavior problems scores and the probability of nonmarital teenage childbearing

Characteristic	Model 1	Model 2	Model 3
Academic test scores			
Letter-word	–0.005 (0.023)		
Passage comprehension		–0.072 (0.025)**	
Applied problem-solving			–0.067 (0.031)*
Behavior Problems Index (BPI) x academic test			
BPI score x letter-word score	0.001 (0.002)		
BPI score x passage comprehension score		0.006 (0.002)**	
BPI score x applied problem-solving score			0.005 (0.002)*
Estimated average marginal effects			
Letter-word			
Women with high BPI scores	0.001 (0.001)		
Women with low BPI scores	0.000 (0.001)		
Passage comprehension			
Women with high BPI scores		0.000 (0.001)	
Women with low BPI scores		–0.002 (0.001)**	
Applied problem-solving			
Women with high BPI scores			0.000 (0.001)
Women with low BPI scores			–0.002 (0.001)*

*p<.05. **p<.01. *Notes:* All models control for the full set of covariates listed in Tables 1 and 2. Figures in parentheses are heteroskedasticity-consistent standard errors. For complete results, including coefficients for control variables, see Appendix Table 1 (Supporting Information).

For example, the probability of teenage childbearing was negatively related to the primary caregiver's passage comprehension score and to family income. Furthermore, the probability of nonmarital teenage childbearing was higher among blacks than among whites, and was higher among respondents who were born to a teenage mother than among respondents who were not. These findings reinforce the results of our descriptive analyses, which showed that teenage childbearing was most common among disadvantaged young women.

When controls were included, in model 2, the coefficient for the composite score remained negative, but shrank in magnitude and was no longer significant. However, when we interacted test scores with the behavior problems measure, in model 3, we found that the relationship between academic achievement and teenage childbearing varied according to the extent of respondents' behavioral problems, although the interaction term was only marginally significant. When we divided the sample by whether respondents' scores on the behavior measure were above or below the median value, the average marginal effect was not significant for respondents with high behavior problems scores, but was marginally significant for those with low scores.

*Complete results for these models, including coefficients for all control variables, are reported in Appendix Table 1 (Supporting Information).

†Strictly speaking, our average marginal effect estimates are interpretable as the association between the probability of nonmarital teenage childbearing and relatively small changes in test scores. Because the calculations described here assume a large change in our academic achievement measures (one standard deviation), we conducted a set of sensitivity analyses in which test scores were expressed in standard-deviation units. Results were qualitatively consistent with the conclusions stated above.

The use of the composite test score as our key independent variable may have obscured meaningful differences in what each subtest measures. We therefore conducted regression analyses that separately included the score for each subtest (summary results reported in Table 3).* The relationship between teenage childbearing and letter-word scores was imprecisely estimated and was very small in magnitude both among respondents with high behavior problems scores and among those with low scores. Indeed, for all three subtests, the average marginal effect estimates for females with high behavior problems scores were small and statistically insignificant. However, for respondents with low scores, the estimates for the passage comprehension and applied problem-solving assessments (models 2 and 3) suggest that a one-point increase in the score on either assessment was associated with a 0.2-percentage-point decrease in the probability of experiencing a nonmarital teenage birth.

In practical terms, these findings imply that there is a strong relationship between test scores and nonmarital teenage childbearing among respondents who were in the bottom half of the behavior problems score distribution. Within this group, the standard deviations of the passage comprehension and applied problem-solving variables were about 13.5 and 15.0, respectively (not shown). Our results thus suggest that a one-standard-deviation increase in test scores within this subpopulation was associated with a decrease in the probability of nonmarital teenage childbearing of 2.7 percentage points (0.2 × 13.5) for the passage comprehension subtest and three percentage points (0.2 × 15.0) for the applied problem-solving subtest. Given that about 6% of respondents with low behavior problems scores experienced a nonmarital teenage birth, these findings imply that within this group, an increase of one standard deviation in the score on either assessment was associated with a 50% reduction in the risk of teenage childbearing.†

DISCUSSION

Our analysis of the relationship between academic achievement and teenage childbearing accounts for an unusually rich array of potentially confounding family background characteristics, demographic variables and state-level contextual measures. Even after controlling for covariates, we found that performance on the passage comprehension and applied problem-solving subtests had a strongly negative relationship with the probability of nonmarital childbearing among teenagers who had comparatively low behavior problems scores. Notably, however, we found no evidence of a corresponding relationship among respondents with higher behavior problems scores. We also found that performance on the letter-word identification subtest was not related to childbirth for either group. To our knowledge, this study is the first to document these striking features of the relationship between scholastic performance and early unwed motherhood.

The publisher of the Woodcock Johnson–Revised examination describes the letter-word subtest as an assessment of

basic academic skills and describes the other two subtests used in our analysis as assessments of the ability to apply such basic skills to the task of solving academic problems.[51] Our findings thus imply that analytical thinking skills are correlated with teenage childbearing, but only for students with relatively few preexisting behavioral problems. These results suggest fruitful avenues for future work. For example, researchers should continue to explore the potentially crucial interaction between academic achievement and behavioral attributes. Policymakers and practitioners would also benefit from a deeper understanding of why the risk of teenage childbearing is closely related to scores on the passage comprehension and applied problem-solving assessments, but not to letter-word test scores.

To the extent that adolescents perceive their academic performance to be a reflection of their future academic and labor market opportunities, our findings are broadly consistent with an emerging literature showing that teenage childbearing is disproportionately concentrated among young women with limited educational and economic prospects.[13–17] Alternatively, one could interpret our results as suggesting that youth with comparatively strong cognitive skills are better equipped to identify the most effective contraceptive methods, secure access to those methods and use them correctly. Under either interpretation, one might expect improvements in cognitive skills to be associated with a reduction in teenage childbearing. Future research might seek to tease out the implications of these competing hypotheses.

Our results also more specifically reinforce the findings of studies showing that schooling success is related to teenage fertility outcomes.[18–21] The current study contributes to this literature by controlling for a range of covariates that have not typically been accounted for in other empirical treatments of this topic, by showing that some dimensions of academic achievement are more strongly correlated than others with nonmarital teenage childbearing and by documenting that the strength of this relationship differs according to the presence of other behavioral problems.

While we controlled for a wide array of individual, family and state-level covariates, our estimates may have been biased by the omission from our regression models of other characteristics that are correlated with both academic achievement and teenage childbearing. For instance, we were unable to account for peer influences, neighborhood characteristics and school quality measures that are uncorrelated with our covariates. The absence of such controls in our analysis could have led to an overestimation of the association between childbearing and academic achievement.*

However, our estimates are biased toward zero to the extent that attrition is especially common among PSID respondents with low test scores and high propensities for out-of-wedlock childbearing. This is a realistic prospect, as respondents eliminated from our analytic sample because of missing data were generally more disadvantaged than respondents who were retained in the sample. On balance, our results suggest that additional research is warranted on the question of whether improvements in academic achievement could help to reduce the incidence of nonmarital teenage childbearing.

*In other regression models, we did in fact include controls for neighborhood quality. Specifically, we controlled for the proportion of families in the respondent's neighborhood who owned their homes and for the primary caregiver's assessment of neighborhood quality and neighborhood safety. We did not report results of these regressions because the values for the neighborhood controls were missing for a large number of respondents. However, our results pertaining to test scores were robust to the introduction of these controls.

REFERENCES

1. Hamilton BE et al., Births: preliminary data for 2013, *National Vital Statistics Reports,* 2014, Vol. 63, No. 2.

2. United Nations, Live births by age of mother and sex of child, general and age-specific fertility rates: latest available year, 2000–2009, no date, <http://unstats.un.org/unsd/demographic/products/dyb/dyb2009-2010/Table10.pdf>, accessed May 27, 2014.

3. Wolfe B and Rivers EM, Children's health and health care, in: Hoffman SD and Maynard RA, eds., *Kids Having Kids: Economic Costs & Social Consequences of Teen Pregnancy,* second ed., Washington, DC: Urban Institute Press, 2008, pp. 221–255.

4. Scher SS and Hoffman SD, Consequences of teen childbearing for incarceration among adult children, updated estimates through 2002, in: Hoffman SD and Maynard RA, eds., *Kids Having Kids: Economic Costs & Social Consequences of Teen Pregnancy,* second ed., Washington, DC: Urban Institute Press, 2008, pp. 311–321.

5. Manlove JS et al., Outcomes for children of teen mothers from kindergarten through adolescence, in: Hoffman SD and Maynard RA, eds., *Kids Having Kids: Economic Costs & Social Consequences of Teen Pregnancy,* second ed., Washington, DC: Urban Institute Press, 2008, pp. 161–220.

6. Kane JB et al., The educational consequences of teen childbearing, *Demography,* 2013, 50(6):2129–2150.

7. Fletcher JM and Wolfe BL, Education and labor market consequences of teen childbearing: evidence using timing of pregnancy outcomes and community fixed effects, *Journal of Human Resources,* 2009, 44(2):303–325.

8. Grogger J and Bronars S, The socioeconomic consequences of teenage childbearing: findings from a natural experiment, *Family Planning Perspectives*, 1993, 25(4):156–161 & 174.

9. National Campaign to Prevent Teen and Unplanned Pregnancy, Counting it up—the public costs of teen childbearing: key data, 2013, <https://thenationalcampaign.org/sites/default/files/resource-primary-download/counting-it-up-key-data-2013-update.pdf>, accessed May 24, 2014.

10. Ashcraft A, Fernández-Val I and Lang K, The consequences of teenage childbearing: consistent estimates when abortion makes miscarriage non-random, *Economic Journal,* 2013, 123(571):875–905.

11. Hoffman SD, Foster EM and Furstenberg FF, Jr., Reevaluating the costs of teenage childbearing, *Demography,* 1993, 30(1):1–13.

12. Levine DI and Painter G, The schooling costs of teenage out-of-wedlock childbearing: analysis with a within-school propensity-score-matching estimator, *Review of Economics and Statistics,* 2003, 85(4):884–900.

13. Chetty R et al., Where is the land of opportunity? The geography of intergenerational mobility in the United States, *Quarterly Journal of Economics,* 2014, 129(4):1553–1623.

14. Colen CG, Geronimus AT and Phipps MG, Getting a piece of the pie? The economic boom of the 1990s and declining teen birth rates in the United States, *Social Science & Medicine,* 2006, 63(6):1531–1545.

15. Driscoll AK et al., Community opportunity, perceptions of opportunity, and the odds of an adolescent birth, *Youth & Society,* 2005, 37(1):33–61.

16. Kearney MS and Levine PB, Income inequality and early nonmarital childbearing, *Journal of Human Resources,* 2014, 49(1):1–31.

17. Cowan BW, Forward-thinking teens: the effects of college costs on adolescent risky behavior, *Economics of Education Review,* 2011, 30(5):813–825.

18. Heckman JJ, Stixrud J and Urzua S, The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior, *Journal of Labor Economics,* 2006, 24(3):411–482.

19. Shearer DL et al., Association of early childbearing and low cognitive ability, *Perspectives on Sexual and Reproductive Health,* 2002, 34(5):236–243.

20. Manlove J, The influence of high school dropout and school disengagement on the risk of school-age pregnancy, *Journal of Research on Adolescence,* 1998, 8(2):187–220.

21. Chetty R, Friedman JN and Rockoff JE, Measuring the impacts of teachers II: teacher value-added and student outcomes in adulthood, *American Economic Review,* 2014, 104(9):2633–2679.

22. Institute for Social Research, *PSID Main Interview User Manual: Release 2013,* Ann Arbor, MI: Institute for Social Research, 2013.

23. Hofferth SL et al., *The Child Development Supplement to the Panel Study of Income Dynamics,* Ann Arbor, MI: Institute for Social Research, 1997.

24. Institute for Social Research, *PSID Transition into Adulthood Study 2011: User Guide,* Ann Arbor, MI: Institute for Social Research, 2012.

25. Amato PR, The impact of family formation change on the cognitive, social, and emotional well-being of the next generation, *Future of Children,* 2005, 15(2):75–96.

26. Bronars SG and Grogger J, The economic consequences of unwed motherhood: using twin births as a natural experiment, *American Economic Review,* 1994, 84(5):1141–1156.

27. Lichter DT, Graefe DR and Brown JB, Is marriage a panacea? Union formation among economically disadvantaged unwed mothers, *Social Problems,* 2003, 50(1):60–86.

28. McLanahan S and Sandefur G, *Growing Up with a Single Parent: What Hurts, What Helps,* Cambridge, MA: Harvard University Press, 1994.

29. Thomas A and Sawhill I, For love and money? The impact of family structure on family income, *Future of Children,* 2005, 15(2):57–74.

30. Duffy D and Sastry N, Achievement tests in the Panel Study of Income Dynamics Child Development Supplement, *PSID Technical Series Papers,* Ann Arbor, MI: Institute for Social Research, 2014, No. 14–02.

31. Institute for Social Research, *The Panel Study of Income Dynamics Child Development Supplement: User Guide for CDS-III,* Ann Arbor, MI: Institute for Social Research, 2012.

32. An C-B, Haveman R and Wolfe B, Teen out-of-wedlock births and welfare receipt: the role of childhood events and economic circumstances, *Review of Economics and Statistics,* 1993, 75(2):195–208.

33. Kearney MS and Levine PB, Socioeconomic disadvantage and early childbearing, in: Gruber J, ed., *The Problems of Disadvantaged Youth: An Economic Perspective,* Chicago: University of Chicago Press, 2009, pp. 181–209.

34. Lundberg S and Plotnick RD, Adolescent premarital childbearing: Do economic incentives matter? *Journal of Labor Economics,* 1995, 13(2):177–200.

35. Meade CS, Kershaw TS and Ickovics JR, The intergenerational cycle of teenage motherhood: an ecological approach, *Health Psychology,* 2008, 27(4):419–429.

36. Brooks-Gunn J and Duncan GJ, The effects of poverty on children, *Future of Children,* 1997, 7(2):55–71.

37. Conley D and Bennett NG, Birth weight and income: interactions across generations, *Journal of Health and Social Behavior,* 2001, 42(4):450–465.

38. Strully KW, Rehkopf DH and Xuan Z, Effects of prenatal poverty on infant health: state earned income tax credits and birth weight, *American Sociological Review,* 2010, 75(4):534–562.

39. Hamilton BE, Matthews TJ and Ventura SJ, Declines in state teen birth rates by race and Hispanic origin, *NCHS Data Brief*, Hyattsville, MD: National Center for Health Statistics, 2013, No. 123.

40. Abrahamse AF, Morrison PA and Waite LJ, Teenagers willing to consider single parenthood: Who is at greatest risk? *Family Planning Perspectives,* 1988, 20(1):13–18.

41. Powers DA and Ellison CG, Conservative Protestantism and church attendance effects on teen pregnancy and pregnancy outcomes, working paper, Austin: University of Texas at Austin, 2005.

42. Kearney MS and Levine PB, Subsidized contraception, fertility, and sexual behavior, *Review of Economics and Statistics,* 2009, 91(1):137–151.

43. Kane TJ and Staiger D, Teen motherhood and abortion access, *Quarterly Journal of Economics,* 1996, 111(2):467–506.

44. Bailey MJ, More power to the pill: the impact of contraceptive freedom on women's life cycle labor supply, *Quarterly Journal of Economics,* 2006, 121(1):289–320.

45. U.S. Bureau of Labor Statistics, Local area unemployment statistics, no date, <http://www.bls.gov/lau/data.htm>, accessed Nov. 17, 2013.

46. Urban Institute, Welfare rules databook, no date, <http://anfdata.urban.org/wrd/databook.cfm>, accessed Nov. 17, 2013.

47. Urban Institute, Benefit amounts, 2013, <http://www.urban.org/publications/307472.html#ben>, accessed Nov. 17, 2013.

48. U.S. Bureau of Labor Statistics, Consumer price index research series using current methods, <http://www.bls.gov/cpi/cpiursai1978_2012.pdf>, accessed Nov. 17, 2013.

49. Kearney MS and Levine PB, Reducing unplanned pregnancies through Medicaid family planning services, Washington, DC: Brookings, 2008, <http://brookings.edu/~/media/research/files/papers/2008/7/reducing%20pregnancy%20kearney/07_reducing_pregnancy_kearney.pdf>, accessed Nov. 17, 2013.

50. Levine PB, Department of Economics, Wellesley College, Wellesley, MA, personal communication, Nov. 19, 2013.

51. Riverside Publishing, WJ III tests of achievement, no date, <http://www.riverpub.com/products/wjIIIAchievement/pdf/ach_clusters.pdf>, accessed June 9, 2014.

Acknowledgments

The authors are grateful to Phillip Levine for providing data on state abortion restrictions and to Barbara Schone, William Gormley, Harry Holzer, Vanessa Sacks, Kristin Blagg and two anonymous referees for helpful comments and suggestions.

Author contact: *att24@georgetown.edu*

Additional supporting information may be found in the online version of this article at the publisher's website.