Teen fertility and siblings' outcomes: Evidence of family spillovers using matched samples

Online Appendix 1

A. Time Use Data Appendix

The American Time Use Survey data includes details about the primary activity pursued by individuals ages 15 and older from U.S. families (years 2003-2015) throughout a 24-hour period (beginning at 4:00 am), as well as who is with the respondent during the activities (Hofferth, Flood, and Sobek 2017). If respondents report pursuing more than one activity at a time, they must select a "primary" activity. Interviewers also ask respondents about secondary childcare, defined as having a child under age 13 in the respondent's care while doing other activities.

Some of those identified as teen aunts/uncles may really be cousins or some other relative of the child, but it is the closest available proxy for teen aunts/uncles. If teen aunts/uncles are most likely to provide childcare for their nieces/nephews than some other child, the analysis may underestimate the true amount of time teen aunts/uncles spend on childcare.

The School category includes class and homework but not extracurricular activities. Work includes all work-related activities. Childcare as a primary activity includes any time spent focused on the child such as physical care of children, playing with children, or talking with children. All childcare adds time reported spent in secondary childcare for household and non-household children, meaning the teenager may be cooking, eating, watching TV, etc., as a primary activity, but also reports a child being in their care. Time with friends could include friends at school.

B. Identification of Teen Aunts/Uncles

I flag teen mothers by either the birthday method or the school district method, but I do not identify every teen mother in the county.[1] If I do not identify a teen mother, I would not identify her siblings as teen aunts/uncles. Potential misclassification highlights the importance of using more than one match per teen aunt/uncle. Very roughly, if I identify about half of the teen mothers, and if every unidentified teen aunt/uncle is matched to an identified teen aunt/uncle, then by using five matches about 20% of the control group is actually an unidentified teen aunt/uncle based on the number of matches in the data.[2] This would attenuate the results if the unidentified teen aunts/uncles do not differ from the identified teen aunts/uncles.

One option to address under-identification of teen aunts/uncles would be to rescale the coefficients to account for attenuation. However, it is not obvious that every unidentified teen aunt/uncle was matched to an identified teen aunt/uncle, and I do not know the count of unidentified teen aunts/uncles to use for rescaling. Another solution would be to increase the number of matches to crowd out the unidentified teen aunts/uncles; the tradeoff with expanding the matches is that each additional match is less like the treated subject. Appendix Figure A3 shows the estimated difference in test scores between the teen aunts/uncles and their IND+FAM matched controls using 1-25 matches. As expected if the teen aunts/uncles are not affected by the pregnancy itself, the estimated coefficient is always about zero in the year of pregnancy (t=-1, Panel A), regardless of the number of matches. Panel B displays the estimated effects by match count once the baby arrives in the home (year t=0). When there is only one match, and it is

[1] I have access to a subsample of students, which makes comparing the count of teen moms to the county-level data on teen births difficult. Specifically, the data only contains families with at least two siblings with a shared address who attended public school.

[2] A very rough estimate of 50% identification is based on ATUS rates of teen moms having siblings in the home and private school rates in the county.

possible that there are more unidentified teen aunt/uncles in the control sample, the effect is negative but smaller in magnitude (-2.75 percentage points) and only marginally statistically significant (*p*-value=0.078) in the year of birth. When the number of matches expands to two, the coefficient is negative (-3.62 percentage points) and statistically significant (*p*-value=0.008). The coefficient stabilizes around -4 percentage points with three or more matches. To ensure the control sample is mainly true control subjects, I use five samples in the main analysis.

One alternative solution to potential measurement error involves using one measure of identifying the siblings of teen mothers (e.g., identification by birth dates) as an instrumental variable (IV) to estimate the other (e.g., identification by the district method). This analysis estimates the effect for the teen aunts/uncles whose sister's childbirth was identified by birth dates, scaled up by the increase in probability that a teen aunt/uncle whose sister's childbirth is identified by the school is also identified by the birth date method, controlling for the typical observable IND+FAM characteristics. This should account for the group of unidentified teen aunts/uncles who had formerly been in the control pool, much like a treatment-on-the-treated analysis in other instrumental variable models.

I find effects that are larger and at least marginally statistically significant on test scores in t=0 (at -11.2 percentile points, SE=2.7) and attending college (at 17.5 percentage points, SE=10.2). The other effects are not statistically significant but generally slightly larger in absolute size. Effects could be larger for two reasons. First, instrumenting may reduce the measurement error in the number of teenagers who become pregnant. Second, the IV measures local average treatment effects (LATE) for those who are predicted to have a birth under the district method using the birthdate method. If those teen mothers who have both measures (that is, have teen-parenting sisters who do not drop out of school themselves *and* have children who stay in the district until 2005) have larger effect sizes, the IV could overstate the true average treatment effect. Teen aunts/uncles whose sisters stay in school and remain in the district may be more advantaged than others, so this second interpretation is plausible if it is the more-advantaged teen aunts/uncles who are most hurt by their sister's childbirth. That interpretation is not supported by the analysis by tertile of baseline test performance, and I instead take the IV results as evidence that the main results may understate the true effects somewhat due to measurement error. I conservatively retain the main results without IV, but note that future estimated effects may be higher with less measurement error.

C. Teen Mother Analysis

A complementary analysis uses a similar strategy to examine whether the birth also changes the trajectories of teen mothers. The teen mother estimates are interesting by themselves, but they also provide a useful check on the causality of the teen aunt/uncle analysis. If a divergence from their respective matched comparators occurs at different times in the teen mothers and teen aunts/uncles, it is unlikely that some common external event led to pregnancy and drops in scores in the family overall.

This analysis is limited to females who were aged 15-17 in the year of birth. The trajectory models add t=-5 because teen mothers, who are older than their siblings, have more pre-trend data (see Appendix Figure A1). Appendix Table A8 displays logit models predicting the probability of becoming a teen mother. The teen mothers are more likely to be 17 in the year of birth, be the oldest sibling in the family, identify as FRL and black, and attend schools with lower first-observed test scores.

Table A9 displays descriptive statistics for the teen mothers and their matched control groups. Most of the five matched control types are quite similar to their matched teen mothers, though several key differences stand out. The EARLY match has higher test scores than the teen mothers at *t*=-5 and *t*=-2. The JUST BEFORE match has higher percentages of black students in their first-observed school, relative to their matched teen mothers. Both the IND and IND+FAM matches are similar to the teen mothers on all observed characteristics. Relative to the teen mothers the IND+FAM+NBHD matches are younger and have higher test scores at *t*=-2. Note that the family-trajectory models have higher data requirements because the siblings in the families also need to have valid data in two of the four years of pre-years. Thus, there are fewer available matches. Similarly, the final model adds neighborhood requirements that match within a smaller pool, which may explain why there are larger differences on observable characteristics. The benefits may be that they are similar on unobserved neighborhood-level characteristics.

The families of teen mothers are on a downward trajectory relative to other students of the same age. However, the downward pattern exhibited by teen mothers could change following the pregnancy or the birth of the child. Figure 3 in the main paper displays the test score patterns for teen mothers, their first-observed matches, and their trajectory matches. Each line displays the coefficients from regressions of national percentile rank on years relative to birth (*t*=-5 through *t*=0) within the noted combined treatment and control population, holding individual and age fixed effects constant. The light gray box marks the matching period, while the darker gray box indicates the approximate school year the pregnancy began. To be included in the figure, the students had to have the required test scores from before the pregnancy and a test score observed in *t*=0.

While the black and gray lines (representing teen mothers and their matches, respectively) move together in the years used in the trajectory-based matching, there is a divergence in the year closest to the pregnancy (*t*=-1), with the teen mothers increasing their decline in test scores. The test scores remain low for teen mothers in *t*=0, the year of the birth.

As in the teen aunt/uncle analysis, the figure highlights the importance of using trajectory matches, as the teen mothers in the top three panels, which do not account for prior trends, demonstrate divergence from their controls in the years leading up to the pregnancy.

Table A10 examines the outcomes for the mothers. The test score estimates replicate what would be predicted from Figure 3. I begin by confirming the drop in test scores in the approximate year of the pregnancy (*t*=-1). The naïve estimates in Column 1 indicate that teen mothers have test scores 6.5 percentile points lower than all female students from non-childbearing families in the year before birth, after controlling for observable characteristics. The gap is 7.1 percentile points when the control population is limited to EARLY match. Using the more proximate JUST BEFORE match results in an estimated drop in performance of 6.0 percentile points. The estimated effect is -5.1 percentile points based on the IND trajectory, -4.0 percentile points based on IND+FAM trajectory, and -3.8 percentile points based on IND+FAM+NBHD trajectory.

Row 2 examines the test scores at *t*=0, the year the child appeared in the home. The naïve estimates in Column 1 indicate that teen mothers have test scores 7.3 percentile points lower than expected, conditional on the observable controls. The gap is 6.0 percentile points when the control population is limited to the matched control group based on first-observed characteristics. Under the JUST BEFORE match, the estimate is a 5.3 percentile points drop in performance. The estimated effect is -5.3 percentile points based on the IND trajectory and -5.8 percentile points based on IND+FAM trajectory. The IND+FAM estimate is a 21% reduction in the estimated effect size relative to the OLS model. The estimated effect is -5.0 percentile points when restricting the matches to be from the same neighborhood. This estimate may account for unobservable differences that are constant across neighborhood, though there is also a difference in age and baseline test scores between the teen mothers and IND+FAM+NBHD matches. For brevity, below I report the range in estimates in the final two columns.

The probability of grade repetition is 13.5 to 13.9 percentage points higher relative to the matched control groups based on individual and family trajectories, while the probability of dropping out is 19.4 to 22.7 percentage points higher. There is also a small decrease in the probability of exposure to the juvenile justice system in the naïve estimates, with the point estimate ranging from -1.3 to -1.4 percentage points in the first two columns. This matches research using sibling pairs that finds, for instance, that teen motherhood reduces alcohol abuse and other risky behaviors (Fletcher 2011). However, after accounting for trajectories the estimates are a null -0.4 to -1.1 percentage points in the final two columns. Note that the number of observations is much higher for the other high school outcomes than the test score outcomes, both due to higher dropout and that many teen mothers aged out of testing.

Turning to the college-going data, teen mothers are much less likely to attend any college (-13.2 to -20.4 percentage points), obtain any degree or certificate (-6.1 to -9.3 percentage points), and obtain at least a four-year degree (-11.8 to -13.8 percentage points).

Appendix Table A11 conducts the analysis by subgroup for black, non-black, FRL, and non-FRL students. The effects are generally large and robust across subgroups in the high school outcomes. Effect sizes statistically differ between black and non-black groups for grade repetition (5.8 versus 22.5 percentage points, respectively, *p*-value of Hausman test=0.014) and obtaining a four-year college degree (-6.3 versus -19.0 percentage points, *p*-value=0.002). Differences are close to statistical significance between FRL and non-FRL groups for high school dropout (17.1 versus 27.6 percentage points, *p*-value=0.188) and obtaining a four-year college degree (-8.6 versus -19.5 percentage points, *p*-value=0.145). This pattern generally matches prior results finding larger effect sizes for more-advantaged teen mothers (Diaz and Fiel 2016).

Works Cited (Online Appendix Only)

Diaz, Christina J., and Jeremy E. Fiel. 2016. "The Effect(s) of Teen Pregnancy: Reconciling Theory, Methods, and Findings." *Demography* 53 (1): 85–116. https://doi.org/10.1007/s13524-015-0446-6.

Fletcher, Jason M. 2011. "The Effects of Teenage Childbearing on the Short- and Long-Term Health Behaviors of Mothers." *Journal of Population Economics* 25 (1): 201–18. https://doi.org/10.1007/s00148-011-0381-9.

Hofferth, Sandra L., Sarah M. Flood, and Matthew Sobek. 2017. "American Time Use Survey Data Extract Builder: Version 2.6." [Dataset]. College Park, MD: University of Maryland and Minneapolis, MN: University of Minnesota.

Appendix Tables – For Online Publication

Table A1: Descriptive Statistics

	(1) Families w/o teen birth	(2) Teen mothers	(3) Teen aunts/uncles
Female	48.475	100.000	50.312
	(49.977)	(0.000)	(50.051)
Age at birth	N/A	16.308	12.694
		(0.722)	(2.374)
# of siblings in data	2.385	2.581	3.029
	(0.701)	(0.879)	(1.056)
Oldest sibling	45.655	57.196	0.000
	(49.811)	(49.526)	(0.000)
FRL	35.827	74.393	78.586
	(47.949)	(43.687)	(41.065)
Black	12.162	57.757	56.757
	(32.684)	(49.441)	(49.593)
First-observed test score (1-100)	59.319	39.824	42.209
	(26.623)	(24.192)	(26.084)
School avg. FRL	38.050	47.438	47.463
	(17.650)	(15.522)	(15.253)
School avg. Black	15.306	18.942	21.090
	(10.448)	(8.503)	(12.234)
Mean school first-observed test (1-100)	58.605	54.303	53.535
	(9.185)	(7.996)	(8.879)
N	102700	535	481

SD in parentheses. Families without teen births include all children from non-teen-childbearing families. Teen mothers include all teen mothers from families of two or more where the mother gives birth at age 15-17. Teen aunts/uncles include all younger siblings from families where an older sister gave birth at age 15-17.

Table A2: Pre-trends, by group

	Teen mothers			Teen aunts/uncles		
	Individual FE	Individual & age FE	Individual, age & school FE	Individual FE	Individual & age FE	Individual, age & school FE
4 years before birth	-0.623	-0.537	-0.359	-1.115	-0.344	-0.450
	(0.808)	(0.807)	(0.810)	(1.450)	(1.440)	(1.436)
3 years before birth	-2.057*	-2.699**	-2.365**	-5.886***	-4.380**	-4.241**
	(0.874)	(0.877)	(0.875)	(1.505)	(1.475)	(1.482)
2 years before birth	-2.264*	-2.911**	-2.927**	-7.041***	-5.220***	-4.972**
	(1.092)	(1.091)	(1.086)	(1.553)	(1.519)	(1.530)
1 years before birth	-6.161***	-6.052***	-6.440***	-8.780***	-6.917***	-6.870***
	(1.365)	(1.375)	(1.369)	(1.578)	(1.558)	(1.553)
Observations	386268	386268	386254	385832	385832	385818
N	85886	85886	85884	85773	85773	85771
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	No	Yes	Yes	No	Yes	Yes
School FE	No	No	Yes	No	No	Yes

Note: Robust standard errors clustered by family ID. Outcome is the student's percentile of the national distribution on the standardized test for a given year. Models include mothers and their younger siblings 1 to 5 years before birth. All children from non-childbearing families are included to estimate age and school fixed effects (included as noted in headings). Year *t*=-5 is the excluded category.

Table A3: Logit models predicting becoming a teen aunt/uncle

	EARLY matching		JUST BEFORE matching	IND matching		IND+FAM matching
	All	AIC-restricted	AIC-restricted	All	AIC-restricted	AIC-restricted
Female	0.271^{+}	0.265^{+}	0.308*	0.303*	0.308*	0.287^{+}
	(0.141)	(0.141)	(0.142)	(0.142)	(0.142)	(0.150)
Age fixed effects	Ages 12-14 more likely to be siblings in year *t*=-1, relative to age 8. Ages 9-11 statistically indistinguishable from age 8.					
# of siblings in data	0.228***	0.228***	0.221***	0.225***	0.223***	0.144*
	(0.062)	(0.062)	(0.062)	(0.063)	(0.062)	(0.066)
FRL	1.206***	1.233***	1.115***	1.127***	1.121***	1.032***
	(0.199)	(0.195)	(0.199)	(0.200)	(0.199)	(0.215)
Black	1.608***	1.620***	1.492***	1.511***	1.502***	1.363***
	(0.161)	(0.152)	(0.158)	(0.162)	(0.159)	(0.171)
First-observed test score	-0.002					
	(0.003)					
First-observed school avg. FRL	2.370*	2.448*	2.441*	2.273*	2.387*	2.284*
	(1.141)	(1.098)	(1.095)	(1.130)	(1.088)	(1.123)
First-observed school avg. Black	-0.607			-0.542		
	(1.179)			(1.175)		
First-observed school avg. first-observed test score	0.033	0.038^{+}	0.041^{+}	0.035	0.040^{+}	0.044^{+}
	(0.025)	(0.022)	(0.022)	(0.025)	(0.022)	(0.023)
Scores, year t=-2			-0.008**	-0.010^{+}	-0.010^{+}	-0.009^{+}
			(0.003)	(0.005)	(0.005)	(0.006)
Scores, year t=-3				-0.011^{+}	-0.011^{+}	-0.010
				(0.006)	(0.006)	(0.006)
Scores, year t=-4				0.013*	0.014**	0.013*
				(0.005)	(0.005)	(0.006)
Missing score data, year t=-2			0.422	0.388	0.427	
			(0.260)	(0.265)	(0.261)	
Missing score data, year t=-3	N/A	N/A		-0.724		
				(0.588)		
Missing score data, year t=-4	N/A	N/A		-0.062		
				(0.186)		
Family scores, year t=-4	N/A	N/A	N/A	N/A	N/A	-0.011**
						(0.004)
Missing family score data, year t=-3	N/A	N/A	N/A	N/A	N/A	-1.107*
						(0.508)
Constant	-11.417***	-11.945***	-11.657***	-11.135***	-11.644***	-10.405***
	(1.998)	(1.740)	(1.741)	(1.996)	(1.730)	(1.795)
Observations	101680	101680	101680	101680	101680	68542

Standard errors in parentheses. Model predicts probability of becoming a teen aunt/uncle, among the younger siblings of teen mothers and younger siblings from non-teen-childbearing families. Requires at least 2 of 3 prior observations. FAM matching further limited to include individuals with siblings with at least 2 of 3 prior years of data. Marked columns limit variables by minimizing the Akaike Information Criterion (AIC).

Table A5: Estimated effects of teen birth on alternative outcomes measures for teen aunts/uncles

	(1) Baseline	(2) Z-scores	(3) Math only	(4) Reading only	(5) Using FCAT to impute outcome test scores	(6) Using minimum replacement for dropouts	(7) Using minimum replacement for dropouts, quantile regression
Test scores at *t*=0	-4.222***	-0.136***	-4.815**	-3.970**	-4.397***	-4.615***	-3.354
(IND+FAM)	(1.218)	(0.041)	(1.480)	(1.530)	(1.196)	(1.242)	(2.717)
N	809	809	827	830	840	846	846
Test scores at *t*=0	-4.390**	-0.147**	-4.844**	-4.200*	-4.543***	-4.856***	-2.728
(IND+FAM+NBHD)	(1.342)	(0.045)	(1.608)	(1.631)	(1.310)	(1.371)	(2.656)
N	755	755	772	775	781	786	786
Fixed effect model	-2.481*	-0.076*	-3.446*	-1.376	-2.242*	-2.242*	
(IND+FAM)	(1.077)	(0.035)	(1.375)	(1.256)	(1.071)	(1.071)	
Observations	6276	6276	6222	6221	6652	6652	
N	1029	1029	1029	1029	1029	1029	
Fixed effect model	-3.710***	-0.119***	-4.959***	-2.363+	-3.497**	-3.497**	
(IND+FAM+NBHD)	(1.101)	(0.035)	(1.416)	(1.275)	(1.089)	(1.089)	
Observations	5669	5669	5623	5609	5982	5982	
N	938	938	938	938	938	938	

Note: Robust standard errors clustered by family ID except for quantile regression. All analyses based on the noted matches. Row 1 and 2 outcomes are test scores in the year of birth. Rows 3 and 4 conduct a fixed effects analysis including all observations from the teen aunts/uncles and their matched controls, excluding *t*=-1. Column 1 is the preferred specification from previous tables. Column 2 estimates the results with the mean national percentile rank converted to a Z-score. Columns 3 and 4 separate the analysis by math and reading, respectively. Column 5 uses imputation from the same-year FCAT scores for those missing their national percentile rank in a given year. Column 6 replaces all students with missing test scores due to dropping out of high school with the minimum score. Column 7 conducts the analysis from Column 6 as a quantile regression at the median.

Table A6: Estimated effects of teen birth on various outcomes for teen aunts/uncles by subgroups for IND+FAM+NBHD model

	(1) Baseline	(2) Female	(3) Male	(4) Black	(5) Non-black	(6) FRL	(7) Non-FRL
Test scores at *t*=0	-4.390**	-4.587**	-3.489+	-4.609**	-3.681+	-4.300**	-6.071*
	(1.342)	(1.669)	(2.087)	(1.696)	(2.201)	(1.490)	(2.998)
N	755	407	348	401	354	572	183
Test scores, with age	-3.710***	-5.095***	-1.987	-4.046**	-3.242*	-3.184**	-5.705*
and individual FE	(1.101)	(1.380)	(1.883)	(1.496)	(1.597)	(1.223)	(2.480)
Observations	5669	3038	2631	3000	2669	4273	1396
N	938	502	436	492	446	712	226
Repeats grade in *t*=0	2.482	3.087	2.171	2.187	3.040	2.539	2.731
or later	(3.803)	(4.821)	(6.041)	(5.099)	(5.793)	(4.199)	(7.296)
N	990	529	461	540	450	764	226
Drops out in *t*=0 or	5.350+	7.136	3.197	2.516	11.599*	5.188	6.603
later	(3.171)	(4.526)	(4.666)	(3.911)	(5.542)	(3.665)	(6.818)
N	990	529	461	540	450	764	226
Juvenile justice in *t*=0	5.986*	3.078	10.543*	5.297	7.889*	5.123+	11.411
or later	(2.823)	(2.847)	(5.223)	(3.898)	(3.966)	(3.086)	(6.976)
N	990	529	461	540	450	764	226
Ever attends any	-9.679+	-9.051	-11.480	-11.301	-8.592	-8.536	-15.066
college	(5.085)	(6.613)	(7.635)	(7.088)	(7.452)	(5.858)	(10.556)
N	664	352	312	343	321	494	170
Obtains any degree or	-3.526	-5.259	-0.257	-4.506	-2.627	-5.184	-2.107
certificate	(4.087)	(6.173)	(5.178)	(5.171)	(6.570)	(4.312)	(9.590)
N	664	352	312	343	321	494	170
Obtains a 4-year	-3.283	-3.506	-3.251	-4.916	-2.763	-5.625+	1.471
degree	(3.463)	(4.977)	(4.445)	(3.523)	(5.662)	(3.233)	(9.505)
N	664	352	312	343	321	494	170

Note: Robust standard errors clustered by family ID. Column 1 is the preferred IND+FAM+NBHD trajectory estimate from the Table 2; later columns repeat the analysis by subgroups.

Table A7: Estimated effects of teen birth on various outcomes for teen aunts/uncles by tertile

	(1)	(2)	(3)	(4)	(5)	(6)
		IND+FAM			IND+FAM+NBHD	
	Lowest tertile	Middle tertile	Highest tertile	Lowest tertile	Middle tertile	Highest tertile
Test scores at t=0	-3.557^{+}	-6.549**	-1.292	-4.225^{+}	-7.726**	-1.942
	(1.925)	(2.175)	(2.093)	(2.163)	(2.470)	(2.405)
N	245	271	293	237	251	267
p-value of Hausman test		0.203			0.233	
Repeats grade in t=0 or later	13.136^{+}	-0.506	6.695	11.252	-6.696	4.014
	(7.059)	(5.869)	(5.489)	(7.278)	(6.011)	(5.699)
N	366	355	363	344	325	321
p-value of Hausman test		0.287			0.126	
Drops out in t=0 or later	-0.006	10.325^{+}	8.346^{+}	-2.110	9.025	8.865^{+}
	(4.590)	(5.686)	(4.644)	(5.202)	(5.736)	(5.026)
N	366	355	363	344	325	321
p-value of Hausman test		0.266			0.209	
Juvenile justice in t=0 or later	5.296	-0.085	11.635*	2.499	1.836	13.275**
	(5.172)	(4.035)	(4.563)	(5.374)	(4.752)	(4.712)
N	366	355	363	344	325	321
p-value of Hausman test		0.141			0.163	
Ever attends any college	-5.684	-18.037*	-0.496	-9.093	-22.113*	-3.280
	(9.067)	(8.989)	(6.817)	(9.626)	(8.667)	(8.174)
N	221	245	274	206	215	243
p-value of Hausman test		0.259			0.257	
Obtains any degree or certificate	-2.268	-11.884^{+}	-4.286	-1.712	-14.955*	5.681
	(5.012)	(6.582)	(8.068)	(4.741)	(5.924)	(8.699)
N	221	245	274	206	215	243
p-value of Hausman test		0.470			0.079	
Obtains a 4-year degree	-4.688*	-6.444	-5.768	-2.182^{+}	-6.853	-0.229
	(2.016)	(5.267)	(7.465)	(1.231)	(4.678)	(8.219)
N	221	245	274	206	215	243
p-value of Hausman test		0.942			0.594	

Note: Robust standard errors clustered by family ID. Analysis conducted by tertile of first-observed test scores for IND+FAM (Columns 1-3) and IND+FAM+NBHD (Columns 4-6). The highest tertile contains the highest scorers based on their first observed scores in the data.

Table A8: Logit models predicting teen motherhood

	EARLY		JUST BEFORE	IND		IND+FAM
	All	AIC-restricted	AIC-restricted	All	AIC-restricted	AIC-restricted
Age fixed effects	Ages 14 and 15 less likely to be siblings in year *t*=-1, relative to age 16.					
# of siblings in data	0.065 (0.060)			0.057 (0.060)		
Oldest child in the family	0.253* (0.107)	0.230* (0.104)	0.246* (0.104)	0.254* (0.107)	0.243* (0.104)	
FRL	0.816*** (0.141)	0.822*** (0.137)	0.749*** (0.138)	0.724*** (0.142)	0.730*** (0.138)	0.693*** (0.182)
Black	1.596*** (0.122)	1.576*** (0.119)	1.489*** (0.120)	1.496*** (0.124)	1.480*** (0.121)	1.378*** (0.155)
First-observed test score	-0.016*** (0.002)	-0.016*** (0.002)				
First-observed school avg. FRL	-0.626 (0.743)			-0.628 (0.734)		-1.427^{+} (0.812)
First-observed school avg. Black	-1.046 (0.894)			-0.992 (0.892)		-0.042** (0.016)
First-observed school avg. first-observed test score	-0.040* (0.016)	-0.022** (0.007)	-0.020** (0.007)	-0.037* (0.016)	-0.020** (0.007)	
Scores, year t=-2			-0.021*** (0.002)	-0.010* (0.005)	-0.013*** (0.004)	
Scores, year t=-3				-0.005 (0.006)		-0.009^{+} (0.005)
Scores, year t=-4				0.000 (0.005)		
Scores, year t=-5				-0.008 (0.005)	-0.009* (0.004)	-0.008 (0.005)
Missing score data, year t=-2			0.280* (0.125)	0.316* (0.128)	0.301* (0.127)	0.386* (0.164)
Missing score data, year t=-3				-0.187 (0.202)		
Missing score data, year t=-4				0.216 (0.158)	0.281^{+} (0.145)	1.027** (0.338)
Missing score data, year t=-5				0.123 (0.133)		
Family scores, year t=-2						-0.010** (0.003)
Missing family score data, year t=-4						-0.654* (0.303)
Constant	-2.161^{+} (1.278)	-3.441*** (0.424)	-3.461*** (0.426)	-2.153^{+} (1.268)	-3.448*** (0.428)	-1.047 (1.205)
Observations	54162	54162	54162	54162	54162	33613

Standard errors in parentheses. Model predicts the probability of becoming a teen mother, among the eventual teen mothers and females from non-teen-childbearing families. Requires at least 2 of 4 prior observations. Marked columns limit variables by minimizing the Akaike Information Criterion (AIC).

Table A9: Descriptive statistics, matched controls for teen mothers

	(1) Teen mothers	(2) EARLY	(3) JUST BEFORE	(4) IND	(5) IND+FAM	(6) IND+FAM +NBHD
Age at birth	16.309	16.259	16.271	16.264	16.309	16.152
	(0.045)	(0.018)	(0.018)	(0.018)	(0.021)	(0.027)
p	.	0.823	0.950	0.921	0.987	0.003
# of siblings in data	2.700	2.529	2.537	2.548	2.702	2.642
	(0.061)	(0.025)	(0.025)	(0.027)	(0.042)	(0.036)
p	.	0.229	0.294	0.417	0.974	0.420
Oldest sibling	56.379	54.792	55.729	53.437	52.593	50.571
(percent)	(3.188)	(1.310)	(1.303)	(1.324)	(1.720)	(1.693)
p	.	0.687	0.463	0.942	0.292	0.105
FRL (percent)	75.720	75.677	75.208	75.313	78.272	76.734
	(2.756)	(1.096)	(1.110)	(1.098)	(1.348)	(1.528)
p	.	0.708	0.852	0.819	0.413	0.751
Black (percent)	57.613	59.167	58.177	59.896	56.214	51.975
	(3.177)	(1.333)	(1.349)	(1.331)	(1.790)	(1.980)
p	.	0.942	0.678	0.856	0.706	0.139
Test score at t=-5	39.811	41.734	40.623	38.903	39.800	42.368
(1-100)	(1.472)	(0.633)	(0.613)	(0.607)	(0.796)	(0.813)
p	.	0.033	0.183	0.943	0.995	0.137
Test score at t=-2	39.192	41.451	37.202	37.079	38.504	42.262
(1-100)	(1.570)	(0.667)	(0.625)	(0.619)	(0.829)	(0.862)
p	.	0.003	0.989	0.918	0.702	0.091
School avg. FRL	47.874	48.739	49.106	48.307	48.233	47.536
(percent)	(1.025)	(0.434)	(0.424)	(0.446)	(0.586)	(0.594)
p	.	0.434	0.235	0.756	0.766	0.781
School avg. Black	19.420	19.727	19.978	19.573	19.590	18.884
(percent)	(0.595)	(0.231)	(0.210)	(0.227)	(0.322)	(0.282)
p	.	0.219	0.076	0.355	0.804	0.423
Mean school first-observed test (1-100)	54.081 (0.533)	53.948 (0.217)	53.720 (0.205)	54.159 (0.221)	54.048 (0.301)	55.095 (0.301)
p	.	0.639	0.335	0.985	0.958	0.103
N	243	1770	1761	1766	1091	1029

SE in parentheses (clustered by family ID). Teen mothers include all females who gave birth at age 15-17 who had at least two of four years of pre-data. EARLY matches include matches from non-teen-childbearing families to teen mothers based on first-observed characteristics. JUST BEFORE matches replace first-observed test scores with scores from two years before birth. IND matches include matches from non-teen-childbearing families to teen mothers based on three-year test score trends and other observable characteristics. IND+FAM matches add three-year family average score trends. IND+FAM+NBHD matches add the requirement that matches be from the same neighborhood as the teen mother at the first observation in the data. Includes *p*-value of *t*-test between matches and teen mothers. Comparison in Columns 5-6 against teen mother samples in Column 1; comparison in Columns 2-4 against a slightly larger sample that does not have the family test score requirement. Test scores reported as nationally norm-referenced percentiles (1-100).

Table A10: Estimated effects of teen birth on various outcomes for teen mothers

	(1) All females	(2) EARLY	(3) JUST BEFORE	(4) IND	(5) IND+FAM	(6) IND+FAM +NBHD
Test scores at *t*=-1	-6.488***	-7.137***	-5.993***	-5.106***	-3.981**	-3.827**
	(1.243)	(1.337)	(1.195)	(1.116)	(1.350)	(1.439)
N	20528	1020	1013	1006	634	643
Mean match outcome	62.513	39.739	39.624	36.651	37.485	39.506
Test scores at *t*=0	-7.297***	-6.049**	-5.298***	-5.262***	-5.760**	-5.026*
	(1.610)	(1.886)	(1.539)	(1.418)	(1.882)	(1.971)
N	18793	639	614	614	372	401
Mean match outcome	62.695	38.158	36.983	34.512	36.536	37.669
Repeats grade in *t*=0	18.282***	14.055***	15.476***	15.063***	13.464***	13.900***
or later	(2.387)	(2.776)	(2.773)	(2.769)	(3.540)	(3.577)
N	42255	2154	2145	2150	1334	1272
Mean match outcome	16.244	28.385	26.875	27.396	28.148	25.900
Drops out in *t*=0 or	22.752***	20.551***	21.964***	21.222***	19.425***	22.687***
later	(2.296)	(2.460)	(2.454)	(2.436)	(3.258)	(3.305)
N	41832	2154	2145	2150	1334	1272
Mean match outcome	9.570	19.010	17.813	18.229	21.152	17.032
Juvenile justice in *t*=0	-1.347*	-1.430*	-0.746	-1.524*	-0.431	-1.147
or later	(0.651)	(0.656)	(0.648)	(0.729)	(0.908)	(0.976)
N	41832	2154	2145	2150	1334	1272
Mean match outcome	1.505	2.500	1.771	2.552	1.646	2.634
Ever attends any	-20.753***	-21.734***	-19.307***	-18.850***	-13.202*	-20.410***
college	(3.397)	(3.977)	(3.883)	(3.870)	(5.267)	(5.313)
N	22169	1252	1270	1251	707	730
Mean match outcome	70.025	59.831	57.793	56.474	55.038	62.074
Obtains any degree or	-13.850***	-15.171***	-11.808***	-9.671***	-6.111	-9.313*
certificate	(2.506)	(2.889)	(2.887)	(2.835)	(3.839)	(3.980)
N	22169	1252	1270	1251	707	730
Mean match outcome	43.777	27.881	25.021	22.487	22.406	26.563
Obtains at least a 4-	-12.655***	-14.490***	-11.914***	-10.216***	-11.844***	-13.831***
year degree	(1.985)	(1.964)	(1.909)	(1.878)	(2.209)	(2.259)
N	22169	1252	1270	1251	707	730
Mean match outcome	32.823	17.458	15.249	13.458	13.985	16.477

Note: Robust standard errors clustered by family ID. Analyses include all controls from Table 1. Column 1 includes all females from non-teen-childbearing families as controls. Column 2 includes matches to females from non-teen-childbearing families to the siblings based on the first-observed characteristics, including first-observed test scores. Column 3 replaces first-observed test scores with scores from two years before birth. Column 4 replaces one observed test score with four-year test score trends (*t*=2, -3, -4, and -5). Column 5 adds four-year family average test score trends. Column 6 adds the neighborhood requirement. All outcomes include one weighted observation from the teen mothers and their controls. Column 1 test scores at *t*=0 includes multiple observations per individual control. Test scores reported as nationally norm-referenced percentiles (1-100).

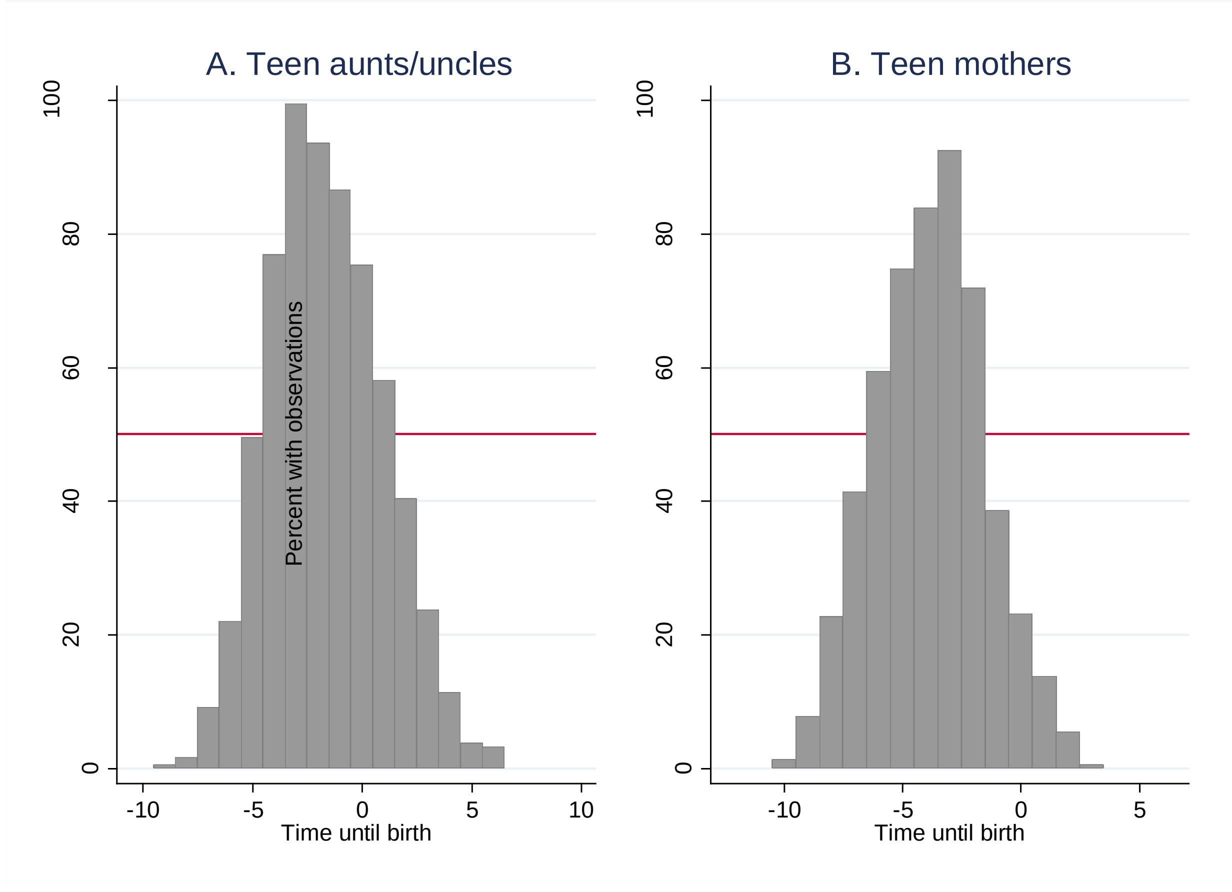
Table A11: Estimated effects of teen birth on various outcomes for teen mothers by subgroups for IND+FAM model

	(1) Baseline	(2) Black	(3) Non-black	(4) FRL	(5) Non-FRL
Test scores at *t*=0	-5.760**	-6.159*	-4.383	-5.228**	-3.505
	(1.882)	(2.431)	(2.773)	(1.804)	(4.337)
N	372	224	148	318	54
Mean match outcome	36.536	31.618	44.560	34.002	50.736
Repeats grade in *t*=0 or later	13.464***	5.844	22.482***	14.503***	9.847
	(3.540)	(4.773)	(5.002)	(4.143)	(6.176)
N	1334	726	608	1022	312
Mean match outcome	28.148	33.529	21.241	31.230	17.045
Drops out in *t*=0 or later	19.425***	19.152***	21.093***	17.109***	27.625***
	(3.258)	(4.332)	(5.089)	(3.746)	(6.754)
N	1334	726	608	1022	312
Mean match outcome	21.152	22.401	19.549	22.713	15.530
Juvenile justice in *t*=0 or later	-0.431	-0.799	-0.032	-0.274	-1.536
	(0.908)	(1.404)	(0.762)	(1.093)	(1.392)
N	1334	726	608	1022	312
Mean match outcome	1.646	2.343	0.752	1.788	1.136
Ever attends any college	-13.202*	-15.025^{+}	-15.183*	-14.380*	-12.030
	(5.267)	(8.235)	(7.019)	(6.358)	(10.884)
N	707	372	335	542	165
Mean match outcome	55.038	57.766	51.678	51.154	68.966
Obtains any degree or certificate	-6.111	-4.664	-10.217^{+}	-5.723	-12.905
	(3.839)	(5.241)	(5.673)	(4.125)	(8.980)
N	707	372	335	542	165
Mean match outcome	22.406	17.984	27.852	18.077	37.931
Obtains at least a 4-year degree	-11.844***	-6.345^{+}	-19.048***	-8.612***	-19.487**
	(2.209)	(3.560)	(2.737)	(2.171)	(6.075)
N	707	372	335	542	165
Mean match outcome	13.985	10.354	18.456	10.192	27.586

Note: Robust standard errors clustered by family ID. Column 1 is the preferred IND+FAM trajectory estimate from the Table A10; later columns repeat the analysis by subgroups.

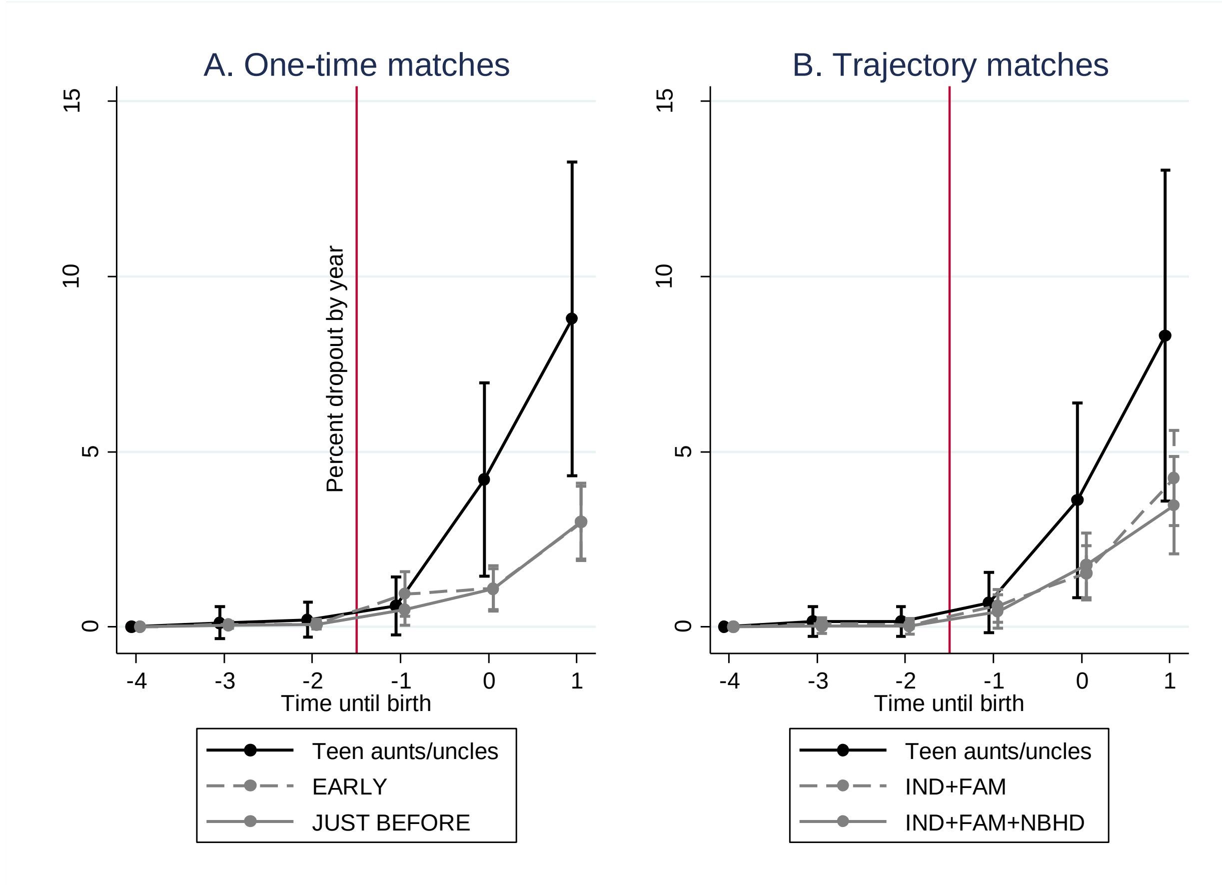
Appendix Figures – For Online Publication

Figure A1: Available pre- and post-birth grades for teen aunts/uncles and teen mothers



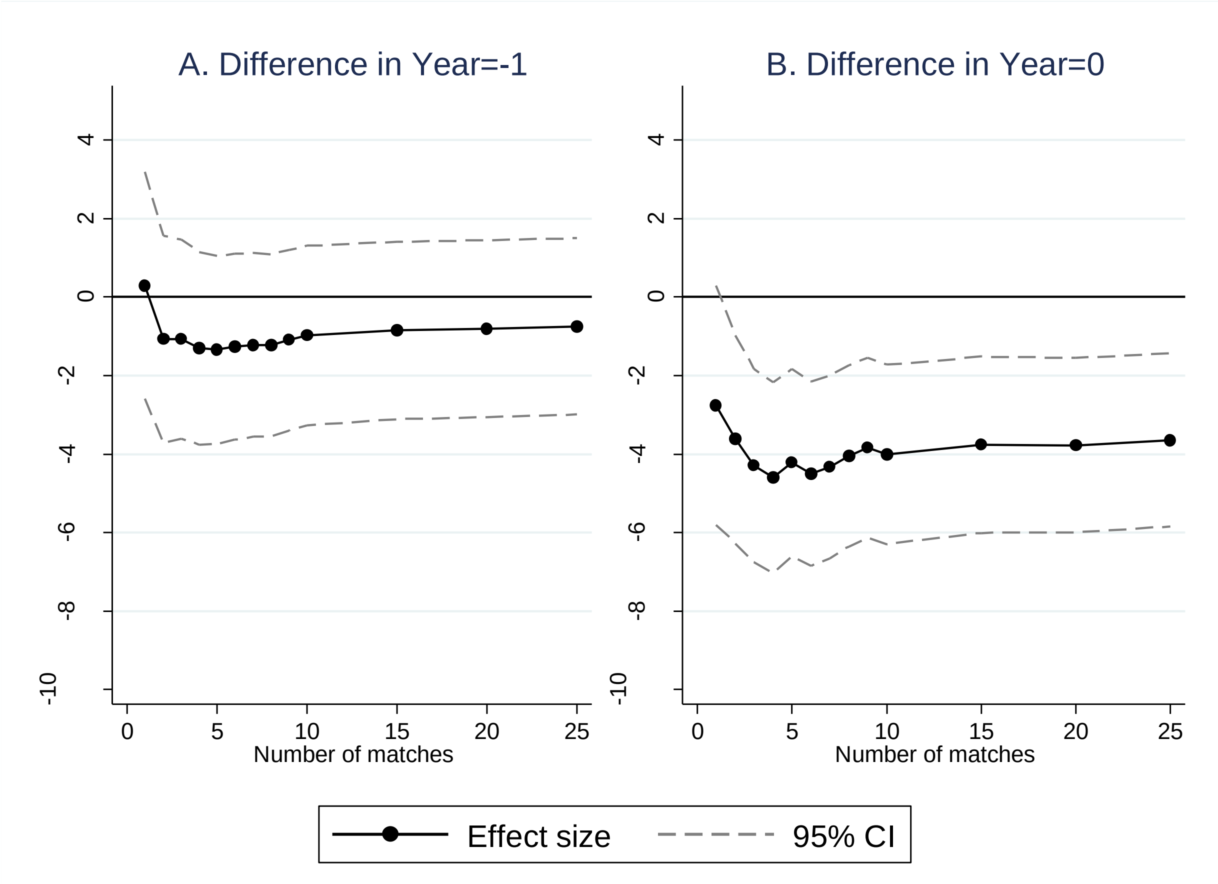
Note: Proportion of teen aunts/uncles and teen mothers with test score data available by years relative to birth for the trajectory matching population.

Figure A2: Dropout rates pre- and post-trends, by group for teen aunts/uncles



Note: Teen aunts/uncles include all younger siblings from families where an older sister gave birth at age 15-17. EARLY matches include matches from non-teen-childbearing families to siblings based on first-observed characteristics. JUST BEFORE matches replace first-observed test scores with scores from two years before birth. IND matches include matches from non-teen-childbearing families to siblings based on individual three-year test score trends, three-year family trends, and other observable characteristics. IND+FAM+NBHD matches add the requirement that matches be from the same neighborhood at first observation. Estimates based on a regression of dropout on years relative to birth (or time relative to the match year for the matches) with person fixed effects within the noted population.

Figure A3: Changes in main regression coefficient as number of matches changes



Note: Displays how the main effects of the IND+FAM model change as the number of matches used in the algorithm changes. The outcome is the year before birth (*t*=-1) in Panel A and the year following birth (*t*=0) in Panel B. Each dot represents the treatment effect from a different regression model. Y axis is the treatment effect size; X axis represents the number of matches used in the initial matching algorithm. Fewer matches mean that a larger portion of the control matches may be from unidentified treatment families; more matches mean that the matched controls are less like the treated individuals on observable characteristics.