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ABSTRACT

We estimate the effects of economic downturns on the birth rates of 15- to 19-year-olds, using county-level business closings and layoffs in North Carolina over 1990-2010 as a plausibly exogenous source of variation in the strength of the local economy. We find little effect of job losses on the white teen birth rate. For black teens, however, job losses to 1% of the working-age population decrease the birth rate by around 2%. Birth declines start five months after the job loss and then last for over a year. Linking the timing of job losses and conceptions suggests that black teen births decline due to increased terminations and perhaps also changes in pre-pregnancy behaviors; national data on risk behaviors also provide evidence that black teens reduce sexual activity and increase contraception use in response to job losses. Job losses seven to nine months after conception do not affect teen birth rates, indicating that teens do not anticipate job losses and lending confidence that job losses are "shocks" that can be viewed as quasi-experimental variation. We also find evidence that relatively advantaged black teens disproportionately abort after job losses, implying that the average child born to a black teen in the wake of job loss is relatively more disadvantaged.

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It is well known that, in the United States, overall fertility falls during economic downturns (Bongaarts and Feeney 1998; Fishback, et al. 2007; Rindfuss, et al. 1988). These aggregate declines, however, mask heterogeneous responses across demographic groups. Different racial, marital status, and education groups diverge in their fertility responses to weakened economic circumstances, in both magnitude and direction (Dehejia and Lleras-Muney 2004; Schaller 2012). The response of teen fertility, in particular, to downturns is even less clear. Most work has not focused on teen fertility, and the little extant research provides inconclusive evidence (Arkes and Klerman 2009; Levine 2002). Contradictory findings may be due to the endogeneity and imprecision of the economic measures used, combined with the low base rate of teen, as compared to adult, childbearing (Martin et al. 2012).

While teen fertility accounts for a relatively small share of U.S. births, it is nevertheless of independent demographic and policy interest. Teen childbearing is believed to be influenced by a different set of decisions than is adult fertility (Levine 2001). Many teens are deciding whether or not to initiate sex for the first time, or whether to initiate sex within the context of their current relationship (Abma et al. 2010), whereas adults are typically sexually active. As a result, teens have three behavioral margins through which to react to economic news (sexual activity, contraception, and abortion) while the vast majority of adults have only two (contraception and abortion). In this paper we are able to provide evidence on all three potential ways in which teens may respond to downturns.

Teens also have different primary activities as alternatives to paid employment. Many teens view education as the main alternative to work, while many adult women view childbearing as the main alternative. Within Becker's (Becker 1960; Becker and Tomes 1976) canonical framework on fertility, this difference means that while the income effects of

downturns, in terms of reduced economic support from family members for new mothers and their babies, may be similar between teens and adults (Caldwell and Antonucci 1997), substitution effects (moving toward childbearing when pushed by market forces away from paid employment) may be substantially weaker for teens. Indeed, research on teens' educational investments suggests that the high school dropout rate declines (Black et al. 2005) and college attendance increases (Betts and McFarland 1995) in response to downturns. Moreover, because teens have longer time horizons for future childbearing, postponing fertility in response to income shocks may be less costly for teens than for adults. In the Becker framework, then, reduced family resources put downward pressure on both teen and adult fertility but teens may be more likely than adults to substitute toward education rather than childbearing when the labor market is weak. Thus, the net response of teen fertility to downturns is predicted to be more strongly negative than the adult response.

There are also, however, reasons that teen fertility might increase in response to downturns. A weak economy increases stress and anxiety (Catalano et al. 2011), and depresses expectations and aspirations about the future (Guiliano and Spilimbergo 2009). These types of changes have been linked to increased teen sexual activity (Buhi and Goodson 2007; Carpenter 2005; Kirby 2001a; Vesely et al. 2004). Moreover, recent work by Kearney and Levine (2012) argues that U.S. teens exhibit higher fertility when they face greater "despair" about the prospects of getting ahead economically.

Finally, changes in teen and adult fertility have different policy implications. Neither pro- nor anti-natalist policies are popular in the U.S., suggesting that policymakers do not have strong opinions about the current overall U.S. fertility rate. By contrast, the U.S. teen fertility rate is the highest in the developed world (Kearney and Levine 2012), and policymakers of all political

persuasions generally agree that teen fertility should be reduced. While recent research argues that teen fertility is a symptom rather than a cause of disadvantage (Kearney and Levine 2012), disagreement on this point remains and concerns about the impact of having a teen mother on child outcomes persist (National Campaign to Prevent Teen and Unplanned Pregnancy 2011).

This study aims to shed light on the relationship between downturns and teen childbearing. The colloquial term "downturn," however, lacks a precise economic definition. National recessions are denoted by negative growth in gross domestic product, but a "bad economy" on a smaller scale generally refers to weak demand in the local labor market. The most easily available (and therefore most commonly used) measures of labor market conditions, however— including local unemployment rates, the employment-to-population ratio, or total area income—are influenced by changes in labor supply as well as labor demand. A negative correlation between changes in the employment-to-population ratio and in area fertility, for example, may reflect an impulse to increased childbearing that leads to lower labor-force attachment among women instead of a decline in labor market conditions that drive residents to consider parenthood as an alternative to work.

To avoid these concerns, we instead use a measure of sudden increases in forced separations from employment to capture change in local economic conditions. We measure monthly county-level business closings and layoffs, which, as shown in previous studies (Jacobson et al. 1993; Stevens 1997) and confirmed in our own tests (Ananat et al. 2011a,b), typically occur because of changes in local circumstances that are unrelated to changes in the characteristics of the workers (e.g. increased pressure from globalization). Such job losses are considered exogenous "shocks" to the workers and allow us to estimate the causal effect of local downturns on fertility rates.

We have constructed a dataset of county-level monthly business layoffs and closings for North Carolina from 1990 to 2010, and we combine these data with vital statistics records of births among women ages 15-19 in North Carolina counties over the same period. We use the timing of job loss relative to gestation, which is included in the birth record, to estimate whether variation in the fertility rate is driven by changes in abortion or pre-conception behaviors. We infer that changes in the birth rate arising from job losses that occur zero to four months post-conception reflect changes in abortion behavior (as these pregnancies already existed when the job loss occurred). We infer that changes in the birth rate arising from job losses that occur one to nine months pre-conception reflect the net effect of changes in contraceptive practice and sexual activity as well as decisions about abortion made after conception. We also conduct falsification tests in which we measure the effect of job loss seven to nine months after conception on births, because teens cannot alter their fertility decisions so close to giving birth. Significant results in these tests would suggest either that job losses do not come as a surprise or that some other community change simultaneously leads both to job losses and to changes in teen fertility. We also utilize data from national surveys to provide additional evidence on sexual activity and contraceptive practices.

We examine outcomes separately for white and black teens.[1] While both white and black communities experience and are affected by job loss (Ananat et al. 2011b), black teen fertility may respond differently to local job losses than white teen fertility does, for two reasons. First, underlying patterns of teen reproductive behavior vary by race. In 2008, the white teen birth rate in the U.S. was 26.7 per 1,000; the black teen birth rate was 62.8 per 1,000 (Martin et al. 2010). In North Carolina, rates were 32.8 for whites and 64.4 for blacks (authors' calculation). White

[1] In the early years of the sample the Latino population in North Carolina was too small to provide stable county-level measures of teen birthrates. Throughout the paper, the terms "white" and "black" are used to refer to non-Hispanic members of those racial groups.

teens also use contraception less consistently than blacks, but blacks have higher pregnancy rates and are disproportionately more likely to have an abortion (Jones et al. 2010; Martinez and Copen 2010). This apparent contradiction in contraception use and pregnancy rates could be due to differences in sexual activity between black and white teens. These different underlying patterns may also change in divergent ways in response to community-wide job losses. Second, black teenagers may feel the economic effects of job loss more immediately than whites. Black families may be more likely to directly experience job loss than white families (Kletzer 1998). Given that black teenagers are more likely to live in households with lower incomes and fewer assets (Darity and Nicholson 2005), their families may also be less able to buffer the economic consequences of job loss. Among those not experiencing individual or family job loss first-hand, black teenagers may also be more worried than whites about their future job prospects, as minority workers are more vulnerable to economic downturns than white workers (Kletzer 1998).

Our study makes several contributions to the literature. First, ours is the first study of teen fertility to use forced job losses, rather than the unemployment rate, to determine the causal relationship between economic downturns and teen birth rates. As discussed above, forced job losses, unlike changes in other measures of the local labor market, are likely to be exogenously related to changes in fertility. Moreover, business closings and layoffs represent unequivocally bad economic news. By contrast, changes in other measures, such as the unemployment rate, are an ambiguous measure of changes in economic circumstances. That rate can go up because positive economic news or a promising new job placement program draw new potential workers into job search, and it can go down if workers become discouraged in their search and drop out of the labor market. Although measures such as the employment-to-population ratio or total local

income are unaffected by discouraged workers, such measures may change spuriously for other reasons (e.g., because women decide to leave work to start families, or because changing technology causes workers to voluntarily go back to school). Reliance on any of these more traditional measures as the measure of a bad economy may partially account for the inconclusiveness of past studies on the effects of downturns (e.g. (Arkes and Klerman 2009; Levine 2002). Using forced job losses ensures that our measure of economic change is both exogenous and clearly negative.

Second, our study is the only one of which we are aware to utilize monthly, rather than yearly or quarterly, measures of economic circumstances and of teen births. Monthly data are critical because they allow us to calculate the elapsed time between the month of the negative economic shock and the month of conception, permitting us to separately distinguish termination and pre-conception fertility responses to job loss. Monthly data also allow us to precisely identify how long economic shocks continue to influence teen fertility after they occur. Third, this is the first study to estimate the effect of local job loss on county-level birth rates. Using a more highly resolved geographic unit allows us to more closely measure local economic circumstances. North Carolina is the only state to provide a long-term panel of job loss estimates at the county level. Fourth, to bolster our results from North Carolina, we utilize national-level data to demonstrate that the behavioral responses found in North Carolina reflect those in the U.S. overall and to lend insight into the mechanisms by which teen fertility falls. Finally, our data set includes data through 2010, making our results reflective of current patterns of teen childbearing, and therefore directly relevant to the most recent economic crisis.

We find that black but not white teens reduce their childbearing in response to local job losses. Reductions are concentrated among black teens who are relatively advantaged, as proxied

by teens having made age-appropriate educational progress. Evidence from the timing of job loss and from surveys suggests that reductions are driven by all three potential channels: increased abortion; increased use of contraception; and decreased sexual activity. Job losses that occur seven to nine months after a conception do not affect teen birth rates; passing this falsification check suggests that job losses are a surprise to the community and provides confidence that job losses are exogenous to fertility behavior. Complementary models on women ages 20 to 24 find small and insignificant effects of job loss on fertility, consistent with the hypothesis that the pressures of downturns are more uniformly and strongly negative for teen fertility than for young adults' fertility.

Method

Data

Birth data come from the North Carolina Detailed Birth Record Database (NCDBR). The NCDBR contains information on all live births in the state, obtained through the long form birth certificate. It includes maternal demographic information, including age, race, and residence at time of delivery. The data include births that occurred to white or black women who were between the ages of 15 and 19 and resided in North Carolina, totaling 231,712 births between January 1990 and June 2010.[2] County-level monthly birth rates for white and black teens were generated to serve as the dependent variables in the analysis. Birth rates were indexed by the month of conception, rather than the month of delivery, using the exact date of birth and gestational age at birth (reported on the long form birth certificate) to calculate the date of conception. Birth rates for each county-month were calculated as the number of births conceived

[2] In July 2010, NC instituted a new birth certificate form, with changes in the type and measurement of outcomes, and post-June data are not comparable to pre-June data

that month in that county to women in that age and race group per 1,000 women in that age and race group in that county in that year.[3] The monthly birth rates were then annualized (multiplied by 12) for ease of interpretation.

The independent variable of interest, community-wide job loss, comes from the North Carolina Job Loss databank (NCJLD). The NCJLD uses data from the North Carolina Employment Security Commission (NCESC) to construct monthly information on any business that closes or lays off workers. The NCESC gathers information from both firms and a statewide survey of newspaper accounts of closings and layoffs. The NCJLD contains, for all 100 counties and for the years 1990-2010, the company name, industry, and number of workers terminated. We conduct tests to determine whether fertility behaviors change prior to the job losses (if, for example, community residents hear rumors prior to the job loss and teens alter their fertility behaviors in response); results discussed below suggest that they do not. Total job losses in each county in each month are scaled by the working-age (ages 25-64) population in that county that year. Roughly two-thirds of our job losses reflect firm closings, while the rest represent layoffs.

Job losses vary both across counties and over time. Maximum losses in each county over the time period under observation range from zero, for five small farming communities, to 9% of the working-age population. The intraclass correlation, calculated as the ratio of the between-county variance in job loss to the total variance, is 0.0119. Thus, only 1.19% of the variation in job loss occurs because of variation between counties; the remaining variation arises from within-county variation over time.

[3] We considered three sources of time-varying measures of county population: decennial Census data with linear interpolation used for inter-Census years; estimates from the North Carolina Governor's Office, and Surveillance Epidemiology and End Results estimates from the National Cancer Institute. Each of these sources provided data that correlated above .99 with each other source and estimates are robust to using any source.

Our job loss measure is more likely to reflect exogenous changes in the local economy than is the unemployment rate, which is determined both by economic change and by phenomena such as "discouraged workers" that may separately influence fertility. As one would expect, however, our measure does predict an increase in the unemployment rate. Within counties (controlling for county and year fixed effects and county-specific linear trends), a job loss to one percent of a county's working-age population leads to an increase in the unemployment rate the following quarter of 0.49% (standard error=0.06); the effect fades in the next quarter, causing an increase in unemployment relative to baseline of 0.37% (standard error=0.04). The effect continues to fade in subsequent quarters.

The entire period January 1990-June 2010 consists of 24,600 county-months (100 counties in North Carolina, with 12 months per year, over 20.5 years). However, conceptions occurring during months for which job losses for the relevant time periods (either 12 months before or nine months after conception) are not available are excluded from the sample. This restriction eliminates conceptions occurring in 1990, the last three months of 2009, and the first six months of 2010, with 22,500 county-months remaining. We further restrict the sample to a balanced panel of counties that contain at least five white and five black teens during the entire period; 91 counties meet this restriction. The final analysis sample includes 20,475 county-months.

Analytic Plan

We use ordinary least squares regression to model the effect of community job loss on birth rates. The models estimate the effect of the number of recent jobs lost in a given county in a given month on the subsequent birth rates for teens in that county; following Chamberlain

(1982), we include job losses with different timing relative to conception in the same model. We use the following Eq. 1:

$$BR_{cmy} = \varphi_1 \sum_{i=m}^{m+4} JL_{ci} + \varphi_2 \sum_{i=m-9}^{m-1} JL_{ci} + \varphi_3 \sum_{i=m+7}^{m+9} JL_{ci} + \theta_m + \theta_c + \theta_c \times y + \theta_y + \varepsilon \quad (1)$$

where BR_{cmy} is the annualized rate of births to a given demographic group (e.g., white teens) conceived in month *m* in year *y* in county *c* and JL_{ci} represents the number of jobs lost to closings and layoffs in that county *c* in month *i*, as discussed in more detail below. Time is indexed relative to conception date, rather than birth date, because birth dates conditional on conception timing might be affected by a worsening economy (e.g. the share of births that are pre-term might increase). The models include dichotomous indicators for: month of conception (θ_m), in order to capture seasonal variation in conceptions; county of residence (θ_c) and county over-time trends ($\theta_c \times y$), in order to capture permanent and linearly-evolving differences in conceptions by county; and year of conception (θ_y), in order to capture state-wide changes that may affect conceptions in all counties in a given year. Heteroskedasticity-robust standard errors are clustered at the county level to adjust for non-independence of observations within a county over time. All models are weighted by the county-level race-specific population of 15- to 19-year-olds. Unweighted models provide very similar but less precise results.

Using this modeling approach means that estimates isolate the effect of job losses that were "shocks" to a county, relative to the overall economy in the state each year and relative to the county's own gradually evolving labor market. Likewise, estimates isolate birth rate "jumps" in a county, relative to overall birth rates for that demographic group in the state in that year and relative to the county's own gradually evolving birth rate for that demographic group.

Job losses are measured over three time periods relative to pregnancies. First, $\varphi_1$represents the effect of job losses that occur zero to four months post-conception on the

number of already-extant pregnancies that result in births. Abortion behavior, but not contraception or sexual-activity decisions, can affect births on this margin. Second, φ_2 represents the effect of job losses that occur one to nine months pre-conception[4] on the rate of pregnancies conceived and then realized as births. Job losses may affect births on this margin by changing pre-pregnancy health behaviors that affect conception rates (sexual activity and/or contraception) and/or by changing abortion behavior post-conception. Third, $\varphi_3$represents the effect of job losses that occur seven to nine months post-conception on the number of already-extant pregnancies that result in births. We expect that $\varphi_3 = 0$, because teens cannot respond to job losses that occur so close to the birth by avoiding birth. An estimate of φ_3 that is significantly different from zero would suggest either: that teens anticipate job losses; that their observed birthrates are affected by other actions taken in response to job losses, such as migration; or that some other community change is occurring that drives both job losses and teen fertility. Any such explanation would cast doubt on the validity of our identification strategy. Therefore estimates of $\varphi_3$serve as falsification checks.

The underlying rates of pre-pregnancy behaviors or abortion cannot be estimated using North Carolina data, as they are not accurately observed at the county level by demographic group.[5] Instead, *changes* in pre-pregnancy and abortion behaviors are inferred by examining changes in birth rates in response to differently timed job displacement (in addition, in part three of the Results section we examine national evidence on changes in reported pre-pregnancy behaviors). For example, consider an instance of job loss that occurred in January of 2000. Any

[4] When separate measures for job losses in each of a series of three-month intervals preceding the conception are included in a model, effects for one-three, four-six, and seven-nine months are significant and of similar magnitude, while effects more than nine months prior to conception are small and insignificant; results are presented in Appendix Table A1. For efficiency, we combine job losses for one-nine months into a single measure and do not include job losses for earlier periods in our main specification.

[5] Attempts were made to analyze micro-level North Carolina abortion data; however, these data were missing important demographic indicators in such a high percentage of cases as to render the data unusable. Nationally, both black and white teens have significant abortion rates (Jones, Finer and Singh 2010).

deviation from the expected average birth rate from May to September among births with conceptions prior to January (a change in the rate of births in May of at least 20 weeks gestation, or a change in the rate of births in September of at least 34 weeks gestation) would represent a change in the outcome of pregnancies that were already conceived when the job loss occurred. The most likely cause is a change in the termination rate (changes in miscarriage rates are discussed below). Deviations from the expected average birth rate among births conceived in February through November of 2000, after job loss takes place, could by contrast result from any or all of the following: changes in the termination rate, changes in sexual activity, and changes in contraception.

In the text, we interpret our results as a percentage change in the birth rate associated with a 1% job loss to the working-age population. For example, consider a county with 100,000 adults aged 25-64 that experienced exactly one instance of job loss during the period under study. If that job loss occurred on January 1, 2000, and affected 1,000 individuals, then the value of our job loss measure for that county would be 1,000/100,000, or 1.00%, during the post-conception (termination) period for births conceived between September and December 1999, and zero otherwise.[6] An OLS estimate of $\varphi_1 =$ -2 can be interpreted to mean that a job loss to 1% of a county's working-age population on January first resulting in an annualized rate of two fewer births per 1,000 teens who were in their first four months of pregnancy on January first. If the estimate is for black teens, for whom the average county base rate of births conceived over the 1991-2009 period is 74.1, a decline of 2.7% in the birth rate (-2/74.1) would be reported in the text.

[6] For the pre-pregnancy job loss measure, the value would be 1.00% for births conceived between February and November 2000, and zero otherwise.

Results

1. Main Results

North Carolina's (NC) teen birth rate tracks well with the national birth rate (results not presented, but available upon request). Over the period 1991-2010, the NC teen birth rate was always higher than the national teen birth rate, but it followed the same general trend: rising in the early 1990s and declining steadily thereafter.

Table 1 displays descriptive statistics for the community-wide job losses and Table 2 displays descriptive statistics for teen birth rates and teen sexual behavior. Table 1 reports that, in a typical county, on average each month, job losses affected 0.05% of the working-age population; the maximum was 9.01%. During the five months post-conception, the average total job loss was 0.27% and during the nine months pre-conception, the average total job loss was 0.47%. For comparison, during the Great Recession (December 2007 to June 2009), the average monthly rate of job loss nationally was 0.22%.[7] Consistent with other research on teenage fertility (Hamilton et al. 2010), the average county-level black teenage birth rate was nearly twice as high as it was for whites (Table 2).

Table 3 presents the results of estimating Eq. 1 for all teens, divided by race. [8] Results indicate that job losses have no effect on the fertility rate of white teens, but have a negative effect on the fertility rate of black teens. We can reject that effects of either pre-conception or zero-four month post-conception (early pregnancy) job losses are the same for blacks and whites (p=.020 for the difference between early pregnancy estimates for blacks and whites; p=.0001 for

[7] Authors' calculations, using data obtained from the US Bureau of Labor Statistics.

[8] In other specifications, we considered whether job loss was non-linearly related to teen fertility, by squaring job loss, by logging job loss, and by dividing our continuous measure of job loss into dichotomous categories (e.g., no job loss, .01 to 1% job loss, etc.) We also considered specifications in which the effect of job loss varied by the level of pre-existing unemployment. We found little evidence supporting a non-linear model of the relationship between job losses and teen fertility, or that the effect of job loss varied by levels of pre-existing unemployment.

the difference between pre-conception estimates for blacks and whites). Effects for blacks are large in magnitude: job losses that occur zero to four months after conception to 1% of the working-age population decrease the birth rate by 1.15 births per 1,000; job losses that occur one to nine months before conception decrease the birth rate by 1.74 births per 1,000 ($p < .05$ for both). These changes in births represent a 1.6% to 2.4% decrease in the birth rate of black teens. The estimated effects on black teen fertility for pre- and early-pregnancy job losses do not differ from each other ($p=.379$), leaving it unclear whether black teens respond to job loss only by adjusting their termination behavior in response to both pre-conception and early-pregnancy shocks, or whether pre-conception behaviors also change when teens receive information about changes in their communities' economic circumstances prior to conception. We explore this topic further in Section 3.

Job losses seven to nine months after conception do not affect the birth rates of either blacks or whites; point estimates for both groups are small and insignificant. Further, for blacks, the effect of job losses seven to nine months after conception differs significantly from the estimate for pre-conception losses ($p=.069$), and are in the opposite direction from both pre-conception and early-pregnancy losses. These findings provide evidence that estimates of the relationship between job losses and fertility are not driven by spurious factors, as such factors would be unlikely to operate just before or four months after but not seven months after conception. These findings also provide reassurance that job losses are unanticipated; if information about upcoming job losses typically leaks prior to occurrence, then teens would be able to respond to the news prior to its announcement in their third trimester.

Table 4 presents the results for the effect of job loss on the birth rates of young women ages 20-24. Job loss does not affect the birth rates of either white or black women in their early 20s.

Point estimates for black young adult women are one-third to one-half the size of those for black teens, and do not approach statistical significance. Further, because birthrates are much higher for adult women than for teens, the point estimates imply potential birthrate changes of only 0.3% to 0.5%, nearly an order of magnitude smaller than our estimates for teens. The null findings among young women are supportive of the hypothesis that the pressures of local downturns are more uniformly and strongly negative for teen fertility than for adult women's fertility.

2. Specification checks

To further address potential concerns that findings represent a spurious correlation between job loss and fertility rates, we estimate several additional models that test the validity of the main findings. The first set of analyses examines whether out-migration rather than individual fertility declines can account for the observed drop in births, by measuring the relationship between county-level population counts for teenagers and job losses last year (Table 5).[9] Significant effects of job losses on migration would affect the interpretation of the main results, as it would open the possibility that some of the effect of job loss on teenage birth rates might stem from changes in the size or composition of the teenage population in a given county. Results indicate no relationship between lagged job losses and the total number of white female teens or black female teens. Thus, migration does not appear to be driving the results.

In a series of models, we omit the county, the year, or the monthly fixed effects; results are similar in magnitude and direction, although less precisely estimated when fewer fixed

[9] These analyses can only be conducted using SEER data, as SEER measures vary non-linearly within decade, population group and county. Monthly population counts of teenagers are not available. In other work (Ananat, Gassman-Pines and Gibson-Davis 2011) we have estimated the effect of job losses last year on this year's county public school enrollment for various grades and found no relationship; as those data represent actual counts rather than population estimates, they provide a stronger additional falsification test and lend confidence that endogenous migration is not occurring.

effects are included. In other models, each county or each year is dropped one at a time; results are substantially similar across all of these models, indicating that results are not driven by one county or one year. Finally, we run models controlling for county female population over time or for the contemporaneous unemployment rate; again, results are substantially similar. These models provide additional evidence that we have identified a true relationship between community job loss and teen birth rates, and that the main findings are not a spurious result of a particular regression approach or set of observations.

3. Mechanisms

We next explore why the decrease in black teen childbearing occurs. In particular, we examine *who* among black teens appears to reduce their fertility, and *how* they reduce fertility.

In order to answer the first question, we examine changes in characteristics of teens observed giving birth. We use the NCDBR to measure two characteristics that likely identify levels of sociodemographic disadvantage: whether the teen fails to report the father's name on the birth certificate and whether the teen has not made age-appropriate educational progress. We define a teen as having not made age-appropriate educational progress if she has not completed the minimum grade that would be expected for her age (e.g., a teen who is 15 should have at least finished eighth grade; 19-year-olds should have graduated from high school).[10] Following the "marginal child" literature (Ananat et al. 2009; Gruber et al. 1999), we identify those who select out of childbearing when local job losses occur by estimating changes in the average characteristics of those who give birth, using Eq. 2:

$$\ln\left(S_{cmy} = \varphi_1 \sum_{i=m}^{m+4} JL_{ci} + \varphi_2 \sum_{i=m-9}^{m-1} JL_{ci} + \varphi_3 \sum_{i=m+7}^{m+9} JL_{ci} + \theta_m + \theta_c + \theta_c \times y + \theta_y + \varepsilon \quad (2)\right.$$

[10] Other measures of disadvantage, such as whether the mother used Medicaid to pay for the birth, are not available until December 2010.

where S_{cmy} is the share of teens observed giving birth in county *c* in month *m* in year *y*, who have a given characteristic (e.g. failed to make age-appropriate educational progress), and the other variables are as defined in Eq. 1.

Estimates of Eq.2 are presented in Table 6. Consistent with our findings of no change in the birth rate for white teens, we also find no effects of job loss on the markers of social disadvantage for white teens. By contrast, results indicate that job losses, in reducing the black teen birth rate, also alter the composition of the population of black teenagers who give birth. Black teens with lower levels of disadvantage become less represented among black teens giving birth in the first few months after job losses occur. Job losses zero to four months post-conception increase the share of black teens giving birth who have not made age-appropriate educational progress by 0.52% and increase the share of black teens giving birth who do not report the father's name on the birth certificate by 0.34%. These point estimates suggest that the entire increase in abortions among those black teens who are pregnant at the time of the job loss occurs among those who have made age-appropriate educational progress and who would have identified the father if they had given birth. By contrast, there is no change in the educational composition of black teens giving birth among those who conceive *after* job losses, and the share reporting father characteristics actually increases, a point we explore further below.

We next examine how teens appear to reduce their fertility. From our earlier results, we have evidence that black teens reduce fertility by increasing pregnancy terminations, and our results are consistent with the possibility that black teens increase pregnancy avoidance as well. Our data do not provide direct evidence on pregnancy avoidance, however, and it is possible that job losses, even when they occur prior to conception, do not affect conceptions but instead merely increase abortions. Moreover, if job losses do increase pregnancy avoidance, they could

do so through either reduced sexual activity, increased use of contraception, or both. Unfortunately, no representative data on sexual activity and contraception use exist at the county level. Therefore, in order to investigate whether and how pregnancy avoidance behaviors change in response to job losses, we turn to U.S. state-level survey data on sexual activity and contraceptive behaviors and U.S. state-level data on job loss.

Data on teen sexual behaviors are taken from the Youth Risk Behavior Survey (YRBS), which is fielded biannually in February through April of odd years by the Centers for Disease Control (CDC). In states that agree to participate, the CDC draws a probability sample of all high schools in the state and then randomly samples individual classes from within each high school (e.g., Mrs. Smith's second period Algebra class). All students in the selected classes comprise the sample for that state. If the overall survey response rate is at least 60%, the CDC considers the results to be generalizable to the entire population of the state's high school students. Only years in which states' response rates meet this threshold are included in the analyses.

The YRBS asks teens to report on recent sexual behaviors. We consider three behaviors: whether the teen has had sexual intercourse in the past three months; whether, among those who have had sexual intercourse, the teen has had sex with two or more partners in the past three months; and whether, among those who have had sexual intercourse, the teen used any method of birth control the last time she had sex. Because this sample is school-based, it will not capture behaviors of teens who are not in school; however, since changes in fertility appear to occur either proportionally or more than proportionally among teens who have made age-appropriate educational progress, these data can nonetheless be informative about the behavioral margins driving fertility reductions.

U.S. state-level job loss data are taken from the Bureau of Labor Statistics' (BLS) Mass Layoff Statistics, which report, for each state and the District of Columbia when available, the number of workers in a year who are affected by mass closings or mass layoffs that last longer than 30 days. [11] Data are available from 1995 to 2009. Summary statistics indicate that on average, 0.72 % of the working-age population files unemployment claims due to mass layoffs and closings each year (Table 1), and the measure has substantial variation in job losses across states and years. For more details on the U.S. state-level job loss data, see Ananat et al. (2011).

In order to identify the effects of job losses on sexual behavior, we estimate Eq. 3:

$$\text{Behavior}_{ist} = \beta \text{JobLoss}_{st-1} + \delta_t + \delta_s + \varepsilon \quad (3)$$

where $Behavior_{ist}$ is the self-reported behavior (e.g. having used contraception the last time she had sex) of teen *girl i*[12] surveyed in state *s* in year *t*. JobLoss_{st-1} is the percent of workers in a state affected by mass job losses[13] for the year-long period up to and including the quarter the YRBS was administered. The fixed effects for state (δ_s) and year (δ_t) are included to control for persistent differences between states and for any event that may have affected all states in a given year. We report heteroskedasticity-robust standard errors that are clustered at the state level. All models are weighted to correct for the YRBS's complex survey design.

Results are presented in Table 7. In response to job loss, black teenagers report no change in the incidence of sex in the past three months, but are significantly less likely to have had two or more sexual partners, and are significantly more likely to report using a method to prevent pregnancy the last time they had sex. White teenagers report no change in the incidence of sex or

[11] "Mass" is defined as 50 or more workers. BLS does not collect data on layoffs or closings affecting fewer than 50 workers.

[12] We are unable to measure outcomes as logged population shares as in equation (2) because of the YRBS's complex survey design. Therefore, we estimate equation (3) as a linear probability model.

[13] The technique used to combine the two measures of job loss available at the state level, separations and total initial claimants (see Table 1), are described in Ananat et al. (2012).

the number of sexual partners; the latter effect is significantly different from the effect for black teens ($p = .07$). White teens are more likely to employ pregnancy prevention in the wake of job losses than they are in the absence of job loss; however, the effect for whites is half the size of the effect for blacks, and the difference between the black and white coefficients is statistically significant ($p < .05$). These results are consistent with the hypothesis that black teens, more so than white teens, increase pregnancy avoidance behaviors in response to job losses. In addition, the reduction in black teens' reports of multiple sexual partners after job losses can help explain why the share of births with no father characteristics reported falls for births conceived after job losses (see Table 5). A shift toward monogamous partnering will increase certainty about paternity, and may improve relationship quality as well. Thus the smaller number of black teens who do conceive and give birth after job losses may on average be more comfortable reporting the father on the birth certificate than were the teens who gave birth prior to the job loss. While results from the YRBS can only be suggestive about the case of North Carolina,[14] estimates are consistent with the hypothesis that the decrease in black teen fertility in North Carolina subsequent to job losses is driven by changes in sexual activity and increased pregnancy avoidance as well as increases in the use of abortion.

Discussion

The decision to bear a child as a teenager is a profoundly important choice with potentially life-altering implications. We find evidence that changes to the local economy affect black teens' childbearing choices. Job losses to 1% of a county's working-age population

[14] State-level estimates of effects of job losses on black and white teen fertility are consistent with our North Carolina estimates. However, because job loss data for other states are only provided quarterly, it is not possible to estimate our models using state-level data.

decrease black teenagers' fertility by about 2%. White teen fertility is not affected, nor is the fertility of women in their early 20s.

Our identification strategy allows us to use the timing of job loss relative to the timing of births to examine how teens' fertility responses to losses vary depending on when, relative to conception, the losses occur. Community-wide job losses significantly affect the realization of black teen births that have already been conceived. Although we cannot measure abortion rates directly, changes in abortion behaviors most likely account for these effects, since job losses zero to four months, but not seven to nine months, after conception affect the birth rate. Local job losses also affect the rate of black teen births conceived one to nine months later. As job losses could affect births that have not yet been conceived by causing changes in sexual activity or contraception, as well as by continuing to affect termination behaviors, we are unable to say exactly what behavioral change or changes account for this decline in births. Using national data, however, we find evidence that job losses decrease the likelihood that a black teen had two or more sexual partners in the past three months and increase the probability that a black teen used birth control the last time she had sex. White teen girls reported a much smaller increase in birth control use, and reported no change in having had two or more partners. The concordance of these self-reported behavior patterns by race nationally with the race-specific birth responses we observe in North Carolina lends confidence that we are identifying a true, rather than spurious, set of causal relationships between job losses and teen fertility.

We find no evidence that local job losses affect the fertility of young women ages 20 to 24. These results are consistent with a Becker-style model in which the effects of local downturns on teen fertility are more strongly and uniformly negative than are effects on young adult women.

Evidence on changes in the composition of the population of teens who give birth subsequent to job losses suggests that relatively advantaged black teens disproportionately increase terminations in response to local downturns. Among those who persist in giving birth when job losses occur during pregnancy, the share of black mothers who do not report father characteristics on the birth certificate increases, as does the share who are not making age-appropriate educational progress. One implication of this pattern is that job losses temporarily worsen the birth circumstances of the average child born to a black teen mother, although sexual and contraceptive behavioral changes after job losses undo some of these effects in the medium term. Concordant with our other findings, we observe no change in the composition of white teens giving birth.

An alternate explanation for declines in teen births is increased miscarriage. We believe this is unlikely to be the correct explanation, for the following reasons. First, it is somewhat unlikely that black but not white teens would experience increased miscarriage; it is even less plausible that black teens who are making age-appropriate educational progress would experience larger increases in miscarriage than would others. Second, although stress has been associated with increased miscarriage risk (Burton and Jauniaux 2004), most of the variance in the miscarriage rate occurs because of congenital anomalies, not because of maternal behaviors or experiences (Goddijn and Leschot 2000; Regan and Rai 2000). The declines in births observed here could only be accounted for by a 20% increase in miscarriage,[15] which is much larger than research on miscarriage has suggested is plausible. Third, the national data showing

[15] The miscarriage rate for women is estimated to range from 11 to 12 miscarriages per 1,000 pregnancies (Knudsen et al. 1991; Regaet al. 1989; Warburton and Fraser 1964). Assuming a miscarriage rate of 12%, then the implied pregnancy rate is 84.2 (based on a birthrate of 74.1 births per 1,000 women and pregnancy rate of 74.1/(100-.12), or 84.2%). A miscarriage rate of 12% would thus translate into 10.1 losses per 1,000 black teens (82.6-74.1) (for miscarriage rate of 11%, 9.2 losses would be found). The observed decrease of over 2 births for this group, if caused by increased miscarriage, implies over a 20% increase in the miscarriage rate due to job loss.

changes in sexual activity and contraceptive use imply that not all of the change in fertility could come from miscarriage.

We also do not believe the drop in observed black teen births is driven by migration among prospective mothers out of the community. While we cannot test migration in a manner completely parallel with the fertility analysis due to data limitations, we find no significant relationship between last year's job losses and this year's teenage population. Moreover, we note that for migration to account for our results, it would have to be of a very specific form and follow a very specific pattern of timing. It would have to differentially occur among black teens; differentially occur among those black teens who have made age-appropriate educational progress; differentially occur among those black teens who report father characteristics on the birth certificate in a way that varies based on pregnancy timing; and occur five to nine months after job losses occur but not one to three months afterwards. By contrast, at the state level, job losses would have to cause out-of-state migration differentially among black teens, and differently among those black teens who do not use contraception and who have high numbers of sexual partners. Thus, we do not believe migration can account for our results.

We therefore believe we have identified true changes in black teens' decision-making about fertility, and not changes in miscarriage or migration. While it is possible that teens reduce fertility because of a perception that their families are now less able to provide them with financial support (an effect likely to be stronger among black teens, because black families have lower levels of resources and assets than white families (Darity and Nicholson 2005)), note that local job losses may change teens' sexual and fertility behaviors even if they do not experience personal financial hardship, and this may be especially true for black teens. For example, in the wake of a changed opportunity structure following job losses, teens, especially those who are

age-appropriate educational progress, may feel an increased impetus to further educational investment; since black teen mothers are much more likely to have made age-appropriate educational progress than white teen mothers (see Table 2), this effect may be concentrated among blacks. In addition, teens may perceive that their communities will be less able to provide them with assistance, and since black families have lower resources than white families, black teens may be particularly dependent on community support.[16] Finally, teenage sexual behavior is determined in part by perceived norms (Kirby 2001b), which can spread quickly throughout a peer group (Fletcher 2007). Job loss that affects some teens' decisions might in this way have ripple effects on other teens, particularly within race group, throughout a community. Unfortunately, we cannot identify which of these mechanisms account for the effects we identify; this is a promising area for future research. In addition, we have concentrated on one state. Although North Carolina is varied in population, its birth rate tracks well with national averages, and our state-level analysis is consistent with our North Carolina findings, further work is necessary to fully document the relationships between job losses and teen fertility across the U.S.

Despite these limitations, we provide important results showing that increases in community-wide job losses decrease the birth rates of black teens, but not of white teens or of young adult women. These results align with those of other studies of fertility (Levine 2002), as well as those showing that blacks are disproportionately impacted by economic downturns (Fairlie and Kletzer 1998; Farber 2004). Moreover, our results underscore that economic contractions have consequences that reach far beyond those typically considered by policymakers.

[16] We note, however, that immediate changes in funding for community services are unlikely to be responsible for the decrease in teen fertility because effects occur too quickly after job losses to be driven by government or non-profit funding cycles.

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Table 1- Summary Statistics: Job Losses as a Percent of Working-Age (25-64) Population

	Mean	SD
North Carolina counties[a]		
0-4 months after conception	.27	(.55)
1-9 months prior to conception	.47	(.76)
7-9 months after conception	.16	(.40)
Overall monthly job loss	.05	(.22)
Sample size	*20,475 county-months*	
Overall annual job loss	.61	(.90)
Sample size	*1,729 county-years*	
U.S. states		
Annual separations[b]	.75	(.48)
Annual total initial claimants[c]	.72	(.54)
Sample size	*506 state-years*	

[a]Measured as the total number of workers who lost jobs during the period as a percent of the county's working age (25-64) population.

[b]Measured as the total number of workers separated from employment due to mass layoffs or mass closings as a percent of the state's working-age (25-64) population.

[c]Measured as the total number of initial claimants for Unemployment Insurance due to mass layoffs or mass closings as a percent of the state's working-age (25-64) population.

Table 2 - Summary Statistics: Birth Rates, Characteristics of Teen Mothers, and Sexual Behaviors

	Whites 15-19 Mean (SD)	Blacks 15-19 Mean (SD)
North Carolina counties		
Birth Rate per 1,000	43.7	73.2
	(36.6)	(72.6)
Sample size	*20,475 county-months*	
Female population	1,842	809
	(2246.9)	(1340.8)
Sample size	*1,729 county-years*	
Share of births to teen mothers:		
who do not report father characteristics	14.93%	30.95%
	(21.35)	(29.59)
Sample size	*17,755*	*15,165*
who have not made age-appropriate	32.32%	22.19%
educational progress[a]	(27.43)	(24.72)
Sample size	*17,750*	*15,160*
U.S. states		
Had sexual intercourse in past 3 months	31.12%	39.88%
	(46.3)	(48.97)
Sample size	*109,523*	*20,548*
Had sexual intercourse with 2 or more partners	14.02%	17.42%
in past 3 months[b]	(34.72)	(37.93)
Sample size	*43,472*	*11,089*
Used any birth control, last time had sex[b]	81.70%	75.76%
	(38.67)	(42.85)
Sample size	*46,697*	*11,318*

[a] Mother has not completed minimum grade that would be expected for her age.
[b] Among those who have ever had sex.

Table 3 - Regressions of Birth Rates on Job Loss, Women ages 15-19, by Race: 1991-2010

	White	Black
Job loss[a]		
0-4 months after conception	.331	-1.149*
	(.331)	(.546)
1-9 months prior to conception	.078	-1.736**
	(.251)	(.385)
7-9 months after conception	.267	.311
	(.424)	(.984)
Number of counties	*91*	*91*
Sample size (county-months)	*20,475*	*20,475*

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses.
Dates refer to dates of conception.

[a]Measured as the total number of workers who lost jobs during the window, as a percent of the county's working age (25-64) population.

†p <.10; *p < .05; **p < .01; ***p < .001

Table 4 - Regressions of Birth Rates on Job Loss, Women ages 20-24, by Race: 1991-2010

	White	Black
Job loss[a]		
0-4 months after conception	.287	-.677
	(.362)	(.888)
1-9 months prior to conception	.280	-.471
	(.396)	(.599)
7-9 months after conception	.500	.408
	(.511)	(1.166)
Birth rate		
Mean	116.3	144.2
SD	(85.42)	(135.23)
Number of counties	*91*	*91*
Sample size (county-months)	*20,475*	*20,475*

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses.
Dates refer to dates of conception.

[a]Measured as the total number of workers who lost jobs during the window, as a percent of the county's working age (25-64) population.

†p <.10; *p < .05; **p < .01; ***p < .001

Table 5 - Regressions of Logged County Female Population, Age 15-19, on Job Loss in the Prior Year, by Race: 1991-2010

	White	Black
Job loss in the prior year	-.0026	-.0007
	(.0034)	(.0037)
Number of counties	*91*	*91*
Sample size (county-years)	*1,729*	*1,729*

Coefficients represent estimated change in the logged female teenage population from job losses to 1% of the county's working-age population.

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses.

†p <.10; *p < .05; **p < .01; ***p < .001

Table 6 - Regressions of Share of Births Where Father Characteristics Aren't Reported and Teen Has Not Made Age-Appropriate Educational Progess, by Race: 1991-2010

	Has not made age-appropriate educational progress[a]		No father characteristics reported	
	White	Black	White	Black
Job loss[b]				
0-4 months after conception	-.0032	.0527**	.0036	.0341*
	(.0193)	(.0173)	(.0207)	(.0162)
1-9 months prior to conception	.0072	-.0184	-.0228	-.0313*
	(.0125)	(.0152)	(.0170)	(.0146)
7-9 months after conception	.0165	-.0411	-.0160	.0204
	(.0219)	(.0362)	(.0267)	(.0300)
Sample size	*17,750*	*15,160*	*17,755*	*15,165*

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses. Dependent variables are logged.

Dates refer to dates of conception.

[a] Mother has not completed minimum grade that would be expected for her age.

[b] Measured as the total number of workers who lost jobs during the window, as a percent of the county's working age (25-64) population.

†p <.10; *p < .05; **p < .01; ***p < .001

Table 7 - Regressions of Female Teens' Sexual Behaviors on Statewide Job Loss, by Race: 1997-2009

Dependent variable:	Sex in last 3 months		Sex with 2 or more partners in last 3 months[a]		Any birth control method, last time had sex[a]	
	White	Black	White	Black	White	Black
Job losses in prior year	.0187	.0118	.0016	-.0615*	.1253**	.2438**
	(.0189)	(.0508)	(.0154)	(.0307)	(.0243)	(.0451)
Sample size	*65,765*	*17,114*	*27,137*	*9,196*	*28,533*	*9,357*

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses.

Dates refer to dates of conception.

[a] Among those who have ever had sexual intercourse.

†p <.10; *p < .05; **p < .01; ***p < .001

Appendix Table A1 - Regressions of Birth Rates on Job Loss, Women ages 15-19, by Race: 1991-2010

	White	Black
Job loss[a]		
0-4 months after conception	.353	-1.109*
	(.342)	(.545)
1-3 months prior to conception	.528	-1.652*
	(.432)	(.661)
4-6 months prior to conception	.121	-2.006*
	(.438)	(.903)
7-9 months prior to conception	-.382	-1.869*
	(.386)	(.761)
10-12 months prior to conception	-.131	-.282
	(.458)	(.842)
7-9 months after conception	.315	.462
	(.434)	(.968)
Number of counties	*91*	*91*
Sample size (county-months)	*20,202*	*20,202*

Heteroskedasticity-robust standard errors, clustered at the county level to adjust for non-independence of observations within a county over time, are in parentheses.
Dates refer to dates of conception.

[a]Measured as the total number of workers who lost jobs during the window, as a percent of the county's working age (25-64) population.

†p <.10; *p < .05; **p < .01; ***p < .001