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Understanding the link between the economy and teenage sexual behavior and fertility outcomes

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Abstract We use individual-level data from the 1997 National Longitudinal Survey of Youth and state unemployment rates to examine how the economy affects fertility and its proximate determinants for several groups based on gender, age (15–17 and 18–20 groups), and race/ethnicity. We find that, for 15- to 17-year-old females, several behaviors leading to pregnancies and pregnancies themselves are higher when the unemployment rate is higher, which is consistent with the counter-cyclical fertility patterns for this group. For 18- to 20-year-old males, the results suggested counter-cyclical patterns of fertility behaviors/outcomes for whites, but pro-cyclical patterns for blacks.

Keywords Fertility · Sexual behavior · Contraception

JEL Classifications J11 · J13

1 Introduction

Although national fertility rates for women over 30 have increased significantly since 1990, those for teenagers have decreased dramatically. Between 1992 and 2000, birth rates for 15- to 17- and 18- to 19-year-old females dropped 28 and 17%, respectively (Ventura et al. 2004). Given the strength of the economy over this period, this national trend in teenage birth rates since 1990 suggests the possibility of

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counter-cyclical fertility. However, such time-series correlations might alternatively be due, for example, to improvements in contraceptive technology and increased concern about AIDS.

Claims of counter-cyclical fertility date back to Butz and Ward (1979) and the literature that followed (McDonald 1983; Kramer and Neusser 1984; and Macunovich 1995). We are aware of only two modern studies using difference-of-difference methods to examine how the economy affects fertility and/or its proximate determinants for teenagers. Levine (2001), using individual data on both women and men from the Youth Behavioral Response Surveillance System (YRBSS), finds that teenage sexual activity among non-black and non-Hispanic high school students (for both men and women) is higher when the economy is weaker, as measured by the teenage employment–population ratio. He also finds evidence for less contraception use when the economy is weaker, although he only finds this for male and female black students and female Hispanic students. Although the results are not consistent in one direction within racial/ethnic groups, the set of significant results across the groups is all consistent with counter-cyclical fertility for teenagers. In contrast, Levine (2002) uses aggregate data and finds that teenage (and adult) births and pregnancies decrease with a higher unemployment rate, suggesting pro-cyclical fertility. One possible reason for the differences between Levine (2001) and Levine (2002) is the different time frames. Another possible reason is the different data sources (e.g., aggregate vs. individual-level data and the fact that the YRBSS only surveys 9th to 12th graders, so it misses people who may have dropped out of high school—perhaps because they became pregnant or had a child).

Using a rich data set, we examine how the economy affects each stage of the fertility decision/outcome tree for teenagers. We apply difference-of-difference methods to state-level economic data and individual-level data on fertility and its proximate determinants from the 1997 National Longitudinal Survey of Youth (NLSY-97). We then use our models to understand the role of the economy in the time-series path of fertility in the 1990s. This advances the work of Levine (2001) by modeling each stage of the fertility behavior/outcome tree and by including a more representative sample of teenagers—i.e., not limited to those in high school.

What might explain the effects the economy has on fertility-related decisions and outcomes? As has been widely noted, economic theory has no clear predictions about whether fertility is pro-cyclical or counter-cyclical (Hotz et al. 1997). In as much as children are consumption goods, we might expect fertility to positively covary with the economy. In as much as raising children is time consuming, we might expect fertility to negatively covary with the economy.

The above are the standard effects the economy could have for women and men. For teenagers, there are additional mechanisms through which the economy could affect fertility and its proximate determinants, all of which still paint an ambiguous picture. Considerations of particular relevance to teenagers include how much unsupervised time they have, their career aspirations, and how much stress they are under—to the extent that teenagers use sex as a means to cope with disappointment (Cooper 1998). Each of these factors could depend on the economy. For example, when the economy strengthens, there would be more role models working and more in established careers. For children growing up in lower socioeconomic settings, a stronger economy would help more women leave welfare. These events would help

female (and perhaps male) teenagers form greater expectations for their future economic success and this would increase the cost of having a child by increasing the earnings lost from hindered education or work experience. Marian Wright Edelman once said: "A bright future is the best contraceptive." A strong economy could help produce perceptions of a bright future. This example is one of the several mechanisms for teenagers.

The mechanisms through which a stronger economy would increase fertility and its proximate determinants for teenagers include:

- Higher income (current income and prospective income) making children more affordable—the income effect;
- Greater employment opportunities for the teenagers' parents, increasing the amount of unsupervised time.

The mechanisms through which a stronger economy could reduce fertility and its proximate determinants include:

- Higher opportunity costs because of greater labor market opportunities—the substitution effect;
- Greater career aspirations raising the costs of having children;
- Greater teenage employment opportunities reducing the amount of unsupervised time;
- Less drug and alcohol use—Arkes (2007) finds that teenage drug and alcohol use decreases when the economy is stronger;
- Less depression/disappointment.

Our interest lies in estimating the total effect of the economy, which would be the sum of the effects through these (and other) mechanisms on fertility and its proximate determinants. Thus, we would not want to control for any factors related to these mechanisms. If we did control for such factors, then we would estimate the effect of the economy beyond the effects through these mechanisms, which would not indicate exactly how the behaviors and outcomes vary with economic changes.

Our results for 15- to 17-year-old females are consistent with the findings in Levine's (2001) individual-level analysis, with the behaviors and outcomes contributing to fertility being counter-cyclical. However, the results are different for the other demographic groups we considered: 15- to 17-year-old males and both 18- to 20-year-old females and males. In fact, for 18- to 20-year-old males, the results suggest behaviors/outcomes leading to pro-cyclical fertility for whites and counter-cyclical fertility for blacks.

In the next section, we discuss the data. We then describe the econometric model in Section 3 and the results in Section 4. We provide discussion on the implications of the estimates in Section 5.

2 Data

This paper combines detailed information on the proximate determinants of fertility from the NLSY-97 with a proxy for the economy. In this section, we describe these data.

2.1 The NLSY-97 data

The NLSY-97 is a panel survey of 8,894 individuals born between 1980 and 1984. The survey has interviewed the respondents annually since 1997. We analyze the data through the seventh round's interviews in 2003. The survey oversamples people who were from low-income households at the time the survey began; sample weights allow for a nationally representative sample.

Although the NLSY-97 was primarily designed to track school-to-work transitions, it also collected a wide range of behavioral factors and outcomes. Among them are various questions on sexual behavior, pregnancies, and the outcomes of pregnancies, which are all asked for both males and females in years in which they are at least 14 years old at the beginning of the year. We use these survey questions to create the following outcome variables, all referring to behavior and outcomes since the last interview or in the past year for the initial 1997 survey: (1) whether had any sex; (2) the log of the number of times had sex, among those who had any sex; (3) whether had any non-contraceptive sex; (4) the log of the number of times had non-contraceptive sex, among those who had any non-contraceptive sex; (5) the percent of sexual activity for which contraception was not used; (6) the percent of sexual activity for which a condom was not used; (7) whether had (or caused) a pregnancy; (8) whether had (or caused a pregnancy leading to an) abortion; (9) whether had an abortion or miscarriage (for females); and (10) whether had (or caused a pregnancy leading to) a birth. This is one of the advantages of this study—we can examine fertility and all of its proximate determinants in a unified framework. The ninth outcome is meant to account for the likelihood, as evidenced by the low number of abortions (as described below), that some women label an abortion as a miscarriage. A common abortion variable used in the literature is "had an abortion conditional on having been pregnant." Unfortunately, because a small number of people had a pregnancy, there were few people for whom this variable is measured. Although we estimated models for this outcome, the standard errors were very large, so the models ended up providing little information. In the Appendix, we describe how we construct our outcomes given the available data, and we discuss issues in interpreting and using the questions and responses.

2.1.1 Descriptive statistics for the outcomes

We create separate samples for males and females and two age-group samples for each gender: 15- to 17-year-olds and 18- to 20-year-olds. The 15–17 grouping is a good sample for our purposes because it is an age group that covers people mostly before what would be their high school graduation. Furthermore, childbearing at these ages is often believed to have the greatest social costs. Because the questions on the outcomes we use are based on time intervals that do not correspond to a given age—specifically, the time since the last interview—we do not use the age at the interview. Rather, the age groupings are based on the average age between the previous and the current interview. For outcomes measured in the first year of the survey, which are measured for the last 12 months, we use the age from 6 months before the interview. If the average age is at least 15 and less than 18, then we assign the respondent to the younger sample. The average age must be at least 18 and less than 21 to be in the older sample.

Tables 1 and 2 present the weighted averages for the ten outcomes for females and nine outcomes for males. Underreporting of these outcomes is always a concern, as teenagers may be reluctant to admit to a pregnancy or may be hindered in their responses due to others present during the interview. However, the pregnancy and birth rates for the younger females are very close to the national pregnancy and birth rates in 2000, as reported in Martin et al. (2003) and Ventura et al. (2004). The pregnancy and birth rates for the female 15–17 group are 5.3 and 3.2%, whereas the national numbers for 2000 (roughly the midpoint of our sample period) are 5.4 and 2.7% for this age group. For the 18–20 group, the pregnancy and birth rates of 10.1 and 7.1% do seem somewhat understated, as they are lower than the national figures of 13.0 and 7.8% (for 18- to 19-year-olds). The number of abortions might also be understated, as there are generally more or just as many miscarriages as abortions in the NLSY-97 data. Jones and Forrest (1992) show that, in the earlier NLSY, the number of abortions reported was only 40% of what would be expected. Their sample was of people mostly in their adult years; we might expect even greater underreporting among teenagers. The pregnancy, abortion, and birth outcomes for males also appear to be greatly understated, as they are far below the level for females. This is highlighted in Figs. 1 and 2.

Figures 1 and 2 show the means of these outcomes by age and gender. If the data were perfect and if males and females had one sexual partner at a time who was in their age group, then we would expect the same outcome means for both genders for a given age. However, nearly all of the outcomes for females have higher means than those for males, and the ratio of births to pregnancies is much smaller for males than for females. This could partly be attributable to females tending to date older males and also some males being unaware of pregnancies they caused. In addition, for pregnancies, abortions, and births, this could be due to the poor quality of data for males. From Table 2, the sum of the percentage of male respondents with an abortion and the percentage with a birth is less than one-half the percentage having caused a pregnancy.

Table 1 Weighted means for the outcomes for the female samples

	Females 15–17			Females 18–20		
	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Had any sex	9,796	0.369	0.483	8,778	0.675	0.469
# times had sex	3,568	70.777	157.614	5,857	123.711	210.426
Had any non-contraceptive sex	9,793	0.158	0.365	8,771	0.264	0.441
# times had non-contraceptive sex	3,565	22.767	94.857	5,850	43.787	149.496
% of time did not use contraception	3,544	0.240	0.360	5,849	0.232	0.367
% of time did not use a condom	3,143	0.362	0.404	5,848	0.484	0.430
Became pregnant	8,426	0.053	0.224	9,449	0.101	0.301
Had an abortion	8,426	0.011	0.103	9,449	0.018	0.134
Had an abortion or miscarriage	10,071	0.027	0.161	9,449	0.037	0.188
Gave birth	8,426	0.032	0.176	9,449	0.071	0.257

Table 2 Weighted means for the outcomes for the male samples

	Males 15–17			Males 18–20		
	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Had any sex	10,179	0.357	0.479	9,125	0.615	0.487
# times had sex	3,886	61.635	157.249	5,716	105.590	197.423
Had any non-contraceptive sex	10,160	0.135	0.342	9,117	0.236	0.424
# times had non-contraceptive sex	3,867	20.532	97.422	5,708	32.296	123.683
% of time did not use contraception	3,810	0.226	0.365	5,707	0.219	0.358
% of time did not use a condom	3,380	0.240	0.363	5,711	0.362	0.414
Caused a pregnancy	6,161	0.032	0.176	9,406	0.077	0.267
Caused a pregnancy leading to an abortion	6,161	0.006	0.079	9,406	0.009	0.097
Caused a pregnancy leading to a birth	6,161	0.009	0.096	9,406	0.024	0.153

2.2 Economic variable

We are interested in the response of fertility and its proximate determinants for teenagers to exogenous changes in the economy. We proxy for the economy with the state unemployment rate, which is a standard measure of the economy's strength. The state unemployment rates, available on a monthly or annual basis, come from the Bureau of Labor Statistics website. The state unemployment rate should be a reasonable proxy for economic conditions that teenagers face, as national trends show that the teenage (ages 16–19) and overall (ages 16 and older) unemployment rates move together, but with much greater volatility for teenagers. We show this in Fig. 3, which plots the annual demeaned unemployment rates. Although our primary

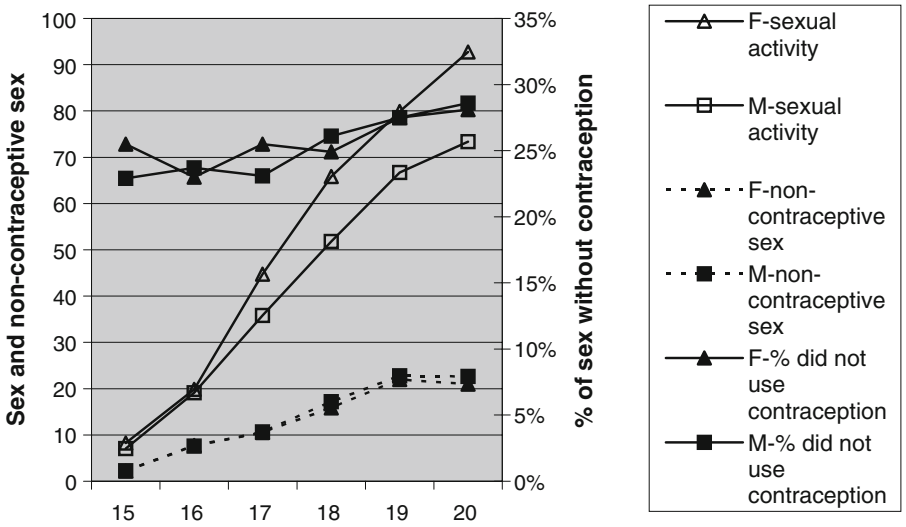

Fig. 1 Sexual behavior patterns, by age and gender. Note: "Sexual activity" and "non-contraceptive sex" are measured as the number of times the respondent had sex and had sex without contraception since the last interview. Source: NLSY–97

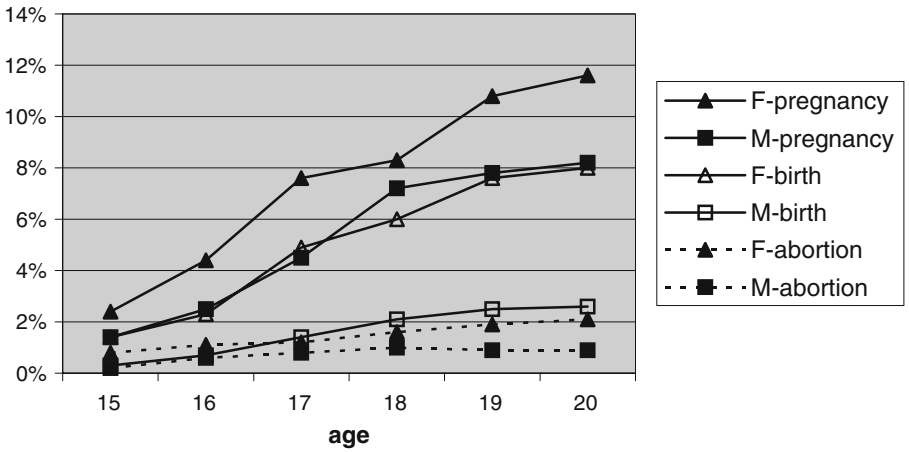

Fig. 2 The percent of respondents involved with a pregnancy, an abortion, and a birth since the last interview, by age and gender. Source: NLSY–97

models use the overall state unemployment rates, we also estimate an alternative set of models that use the teenage state unemployment rates instead.

Our use of the overall state unemployment rates as the primary economic measure differs from previous studies, which used female- or teenage-specific economic variables (Levine 2001, 2002). In some ways, the use of Levine's economic measures addresses a separate question: How do these outcomes respond to changes in the specific labor demand for the targeted group? These more narrowly defined measures have a few shortcomings. They are based on fewer observations than the general unemployment rate, so they have more noise. In addition, it is possible that the female and teenage-specific economic variables are subject to significant

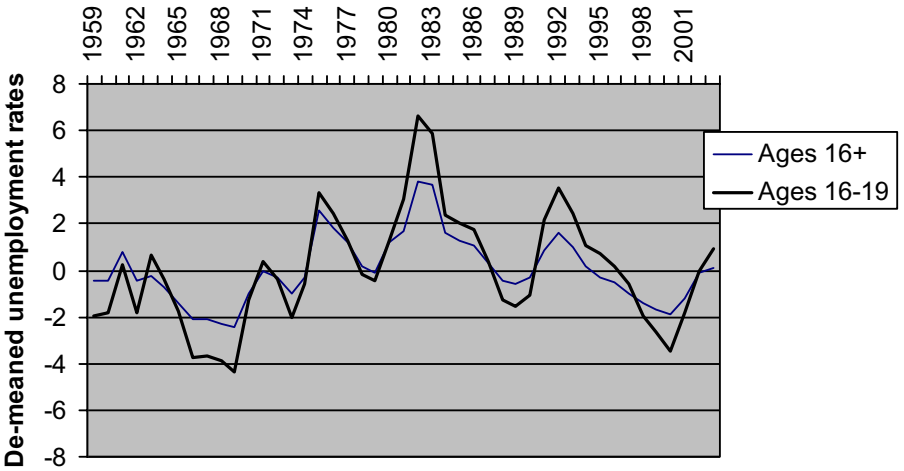

Fig. 3 Demeaned national overall and teenage unemployment rates. Source: Office of the President of the United States (2004)

endogeneity; that is, an exogenous increase in teenage fertility could cause more female teenagers to leave the labor market, which could reduce the teenage employment–population ratio. Alternatively, an exogenous increase in teenage fertility could cause more teenage males to find jobs. There is also a problem in using teenage-specific measures in our study, as they are only available on an annual basis and our outcomes are often measured over time periods covering two separate years. The general unemployment rate could still be slightly affected by exogenous fertility shocks to teenagers, but certainly to a lesser degree. It also has the advantage that it is an easily obtainable measure of the national economy and state economies so that the estimates could be easily applied to changing economic data for predictions.

We use the average monthly unemployment rate between interview dates for an individual because all outcomes are based on the time since the last interview. For the observations from the first round of the survey (1997), the outcomes are based on the past 12 months, so we use the average unemployment rate over that time frame.

3 Econometric model

For the various outcomes, our econometric model is some version of the following reduced-form model:

$$F^*_{ist} = \alpha + X_{ist}\beta + \gamma * UR_{st} + \delta Z_{st} + \mu_s + \mu_t + \varepsilon_{ist}$$

where F^*_{ist} is an index variable for the fertility-related outcome—sexual activity, non-contraceptive sex, lack of contraception, pregnancies, abortions, and fertility—for individual i in state s in year t, X_{ist} is a vector of individual- and family-level characteristics and interview characteristics for person i, μ_s and μ_t represent state and time fixed effects, and UR_{st} is a vector of the current economic measure for state s in period t, and Z_{st} is a vector of other relevant state policies that vary over time. The estimate for γ indicates how the economy (proxied by the unemployment rate) affects the given fertility outcome.

We use logistic models for the dichotomous outcomes (whether had any sex, whether had non-contraceptive sex, and the pregnancy, abortion, and birth variables). We use ordinary least squares for the other outcomes (the number of times the respondent had sex, the number of times the respondent had non-contraceptive sex, the percent of time he/she used contraception, and the percent of time he/she used a condom). We calculate robust standard errors to adjust for heteroskedasticity. There is a possibility that the measurement error from the underreporting on some of these outcomes could cause higher standard errors and lower levels of significance. We use a large set of control variables, which we list in Table 8 in the Appendix. We proceed by discussing many of these control variables.

The state fixed effects control for differences across states that are persistent over time. The year fixed effects control for national changes in fertility, which could result from many factors, including more accessible birth control, national efforts to reduce teen pregnancy, and even changes in the national economy. Because we incorporate state and year fixed effects, the variation in the economic measures we rely on comes from within-state changes over time relative to other states.

Fortunately, this means that we avoid capturing in our estimate of γ the effects on fertility-related outcomes of concurrent but unrelated national factors, such as Magic Johnson's announcement that he had AIDS. We rely on the assumption that within-state changes in the economy relative to other states are not correlated with other factors that affect within-state changes in fertility, once we control for the factors X_{ist} and Z_{st}.

We report robust standard errors clustered on year. This approach is consistent with Moulton's (1990) concern about unobserved heterogeneity at the state-year level in individual-level data and with the concern of Bertrand et al. (2004) about correlation over time in those effects, as well as correcting for arbitrary forms of heteroscedasticity. The justification for the clustering at the state-year level is that Moulton (1990) argues that, when merging aggregate data to individual-level data, it is important to cluster at the level at which the aggregate data are measured. In our case, the central aggregate variable is the unemployment rate. The drawback to this approach is that observations are not independent and identically distributed because of repeated observations for individuals. However, clustering at the individual level precludes clustering at the state-year level.

The individual and family-background factors include some important fertility-related factors known to be correlated with sexual behavior and outcomes. We include age and racial/ethnic dummy variables, indicators of parents' education and family composition at age 12 (which is at least 3 years before our outcome measures). We exclude many factors that are potentially endogenous or that could represent intermediate effects of the economy. For example, we exclude factors such as school enrollment and marital status. Although they are likely strong predictors of many of these factors, we exclude them because they could be affected themselves by these fertility-related outcomes. Furthermore, we exclude family income, hours worked, and current family composition because these could vary with the economy and potentially have effects on teenage fertility and its proximate determinants. Including these variables could capture part of the effect of the economy so that we would not be identifying the total effect of the economy.

The interview characteristics first include the amount of time since the last interview, measured in weeks. This is the time period over which the outcomes are measured, so a longer period between interviews would increase, for example, the probability of becoming pregnant since the last interview. For the initial year, the time period is 52 weeks for the corresponding questions. The interview characteristics also include indicators of what type of person, if anyone, is present at the time of the interview. The types of person include: a parent, a friend, a child, any other relative, and a person who does not fit into one of these categories. This could potentially affect responses of the individual.

The other relevant state policies (in vector Z) first include the maximum AFDC benefits. Most of the changes in other welfare factors—such as time limits, the family cap waiver, and the implementation of Temporary Assistance for Needy Families—occurred by 1997 (see Klerman and Danielson 2004), so that they would not affect our results. We also include in vector Z a set of three variables on state abortion restrictions. These include whether parental notification is required for minors seeking an abortion, whether there are Medicaid funding restrictions for abortions, and whether there is a mandatory delay before obtaining an abortion.

The samples for the various models differ because of nonresponse in the dependent variable and because sometimes a specific group has no variation for an outcome. That is, discrete-choice models with fixed-effects need to drop groups of observations for which there is no variation in the outcome (Chamberlain 1984). In an extreme case—the sample for 15- to 17-year-old males for the outcome "caused a pregnancy that leads to an abortion," for which only 0.6% of the sample has a value of one—the sample is reduced from 6,144 to 539 because most states are excluded for having no variation in the outcome.

4 Results

Tables 3, 4, 5 and 6 present the coefficient estimates on the unemployment rate for the primary models for each of the four gender–age groups: females 15–17, females 18–20, males 15–17, and males 18–20. In each table, we present the results for the full sample, non-Hispanic whites, non-Hispanic blacks, and Hispanics. There are ten separate models for each female group and nine outcomes for each male group. Therefore, the coefficient estimate on the unemployment rate in each cell represents a different model. The sample sizes for these analyses are in Tables 9 and 10 in the

Table 3 Coefficient estimates on the unemployment rate for 15- to 17-year-old females

	All	White	Black	Hispanic
Had any sex	0.144**	0.140	0.277**	0.318
	(0.064)	(0.092)	(0.135)	(0.235)
Log of # times had sex	−0.010	0.064	−0.018	−0.430**
	(0.074)	(0.097)	(0.146)	(0.187)
Had any non-contraceptive sex	0.186**	0.213*	0.202	0.311
	(0.081)	(0.113)	(0.157)	(0.320)
Log of # times had non-contraceptive sex	0.008	0.219	−0.050	−0.758*
	(0.125)	(0.185)	(0.245)	(0.382)
% of time didn't use contraception	0.028*	0.034*	0.001	0.055
	(0.015)	(0.019)	(0.028)	(0.069)
% of time did not use a condom	0.016	0.019	0.010	−0.034
	(0.022)	(0.030)	(0.040)	(0.077)
Became pregnant	0.285*	0.425*	0.224	−0.365
	(0.154)	(0.237)	(0.248)	(0.497)
Had an abortion	0.237	0.007	0.535	1.916
	(0.293)	(0.403)	(0.512)	(1.817)
Had an abortion or miscarriage	0.386**	0.244	0.434	1.057
	(0.166)	(0.252)	(0.295)	(0.654)
Gave birth	0.360**	0.561**	−0.072	0.684
	(0.172)	(0.286)	(0.313)	(0.705)

Each estimate represents the coefficient estimate on the unemployment rate from a separate model. The standard errors are in the parentheses. The models also include year and state-fixed effects and many other variables described in Section 4. Each cell of the table represents a separate regression model.
*Indicate statistical significance at the 10% level
**Indicate statistical significance at the 5% level
***Indicate statistical significance at the 1% level

Table 4 Coefficient estimates on the unemployment rate for 18- to 20-year-old females

	All	White	Black	Hispanic
Had any sex	−0.072	−0.076	−0.063	0.011
	(0.065)	(0.086)	(0.118)	(0.259)
Log of # times had sex	0.061	0.054	0.052	0.394*
	(0.057)	(0.072)	(0.102)	(0.214)
Had any non-contraceptive sex	−0.025	−0.038	0.020	0.343
	(0.064)	(0.091)	(0.153)	(0.229)
Log of # times had non-contraceptive sex	−0.006	0.125	−0.127	0.392
	(0.111)	(0.151)	(0.181)	(0.344)
% of time did not use contraception	0.007	0.009	−0.006	0.055
	(0.013)	(0.016)	(0.025)	(0.045)
% of time did not use a condom	0.023	0.026	0.005	0.010
	(0.018)	(0.021)	(0.030)	(0.047)
Became pregnant	−0.133	−0.187	−0.041	0.102
	(0.095)	(0.143)	(0.188)	(0.314)
Had an abortion	−0.353	−0.539	−0.464	−0.080
	(0.220)	(0.333)	(0.332)	(0.769)
Had an abortion or miscarriage	−0.127	−0.156	−0.049	−0.052
	(0.168)	(0.240)	(0.280)	(0.584)
Gave birth	−0.140	−0.154	−0.052	−0.138
	(0.125)	(0.190)	(0.223)	(0.421)

See Table 3 notes

Appendix. Note again that these models have robust standard errors, with clustering at the state-year level.

For the full sample of younger (15–17) females (Table 3, first column), six of the ten outcomes have a positive and significant coefficient estimate on the unemployment rate: the probabilities of having sex, having non-contraceptive sex,

Table 5 Coefficient estimates on the unemployment rate for 15- to 17-year-old males

	All	White	Black	Hispanic
Had any sex	−0.042	−0.049	−0.020	0.409*
	(0.061)	(0.086)	(0.127)	(0.210)
Log of # times had sex	0.063	0.061	0.177	−0.259
	(0.075)	(0.107)	(0.118)	(0.228)
Had any non-contraceptive sex	−0.075	−0.054	0.178	0.322
	(0.084)	(0.127)	(0.184)	(0.253)
Log of # times had non-contraceptive sex	−0.095	−0.088	0.156	−0.810
	(0.143)	(0.214)	(0.263)	(0.538)
% of time did not use contraception	−0.014	−0.011	0.018	−0.043
	(0.016)	(0.022)	(0.025)	(0.047)
% of time did not use a condom	−0.004	−0.006	0.029	−0.036
	(0.017)	(0.026)	(0.028)	(0.062)
Caused a pregnancy	−0.031	−0.289	0.219	−0.492
	(0.230)	(0.431)	(0.302)	(0.687)
Caused a pregnancy that led to an abortion	−0.053	−27.373	−0.501	5.205***
	(0.413)	(24.031)	(0.682)	(1.589)
Caused a pregnancy that led to a birth	−0.043	−0.474	0.526	−0.800
	(0.313)	(0.762)	(0.388)	(1.985)

See Table 3 notes

Table 6 Coefficient estimates on the unemployment rate for 18- to 20-year-old males

	All	White	Black	Hispanic
Had any sex	−0.057	−0.124*	0.100	0.440*
	(0.059)	(0.074)	(0.155)	(0.225)
Log of # times had sex	−0.027	−0.051	0.227*	0.100
	(0.074)	(0.086)	(0.117)	(0.178)
Had any non-contraceptive sex	−0.066	−0.190**	0.420***	0.309
	(0.075)	(0.080)	(0.161)	(0.227)
Log of # times had non-contraceptive sex	−0.007	−0.016	−0.028	−0.025
	(0.115)	(0.157)	(0.207)	(0.330)
% of time did not use contraception	0.000	−0.022	0.068**	−0.028
	(0.015)	(0.018)	(0.027)	(0.042)
% of time did not use a condom	−0.019	−0.044*	0.063***	−0.030
	(0.018)	(0.023)	(0.023)	(0.039)
Caused a pregnancy	−0.012	−0.278*	0.471**	0.251
	(0.117)	(0.148)	(0.196)	(0.339)
Caused a pregnancy that led to an abortion	−0.239	−0.348	−0.191	4.779***
	(0.272)	(0.372)	(0.545)	(1.667)
Caused a pregnancy that led to a birth	−0.030	−0.658**	0.415	0.264
	(0.202)	(0.318)	(0.271)	(0.582)

See Table 3 notes

not using contraception, getting pregnant, having an "abortion or miscarriage," and giving birth. Interestingly, the unemployment rate appears to affect the extensive margin for sexual activity and non-contraceptive sexual activity, but not the intensive margin. The estimated marginal effects (not reported) are fairly large: a one-percentage-point increase in the unemployment rate increases the probability of having sex by 3.3 percentage points, of having non-contraceptive sex by 2.2 percentage points, of not using contraception (on average) by 2.8 percentage points, of becoming pregnant by 0.8 percentage points, of having an abortion or miscarriage by 0.7 percentage points, and of giving birth by 0.5 percentage points. These estimates all suggest that fertility and the behaviors that contribute to fertility are counter-cyclical for 15- to 17-year-old females. The estimates are generally as high or higher for the white sample, although only four of the outcomes have significant estimates due to the higher standard errors from the smaller sample size. Only one outcome has a significant estimate for blacks (any sex), and the outcomes for the amount of sex had significant coefficient estimates on the unemployment rate for Hispanics. For most of the results for blacks and Hispanics, we cannot distinguish between "no effect" and "insufficient power" due to smaller sample sizes (i.e., the confidence intervals cover substantively large effects).

For 18- to 20-year-old females (in Table 4), the estimates on the unemployment rate are almost all insignificant. For 15- to 17-year-old males (Table 5), the estimates are mostly negative for the full sample and the white sample, but none are significant. For black and Hispanic 15- to 17-year-old males, the estimates are mostly positive, but only two estimates are significant for Hispanics: Having sex and causing a pregnancy leading to an abortion are counter-cyclical.

Differences across race/ethnicity become apparent for the 18- to 20-year-old male sample (Table 6). None of the estimates are significant for the full sample. However,

Table 7 Comparison of coefficient estimates on the overall state unemployment rate (the original model) and the teenage unemployment rate

	Females				Males			
	15- to 17-year-olds		18- to 20-year-olds		15- to 17-year-olds		18- to 20-year-olds	
	Original model	Teenage unemp. rate	Original model	Teenage unemp. rate	Original model	Teenage unemp. rate	Original model	Teenage unemp. rate
Had any sex	0.144**	0.011	−0.072	−0.010	−0.042	−0.004	−0.057	−0.017
	(0.064)	(0.014)	(0.065)	(0.015)	(0.061)	(0.015)	(0.059)	(0.014)
Log of # times had sex	−0.010	−0.018	0.061	0.016	0.063	−0.003	−0.027	0.022*
	(0.074)	(0.018)	(0.057)	(0.014)	(0.075)	(0.017)	(0.074)	(0.013)
Had any non-contraceptive sex	0.186**	0.007	−0.025	−0.036***	−0.075	−0.013	−0.066	−0.009
	(0.081)	(0.018)	(0.064)	(0.013)	(0.084)	(0.021)	(0.075)	(0.016)
Log of # times had non-contraceptive sex	0.008	0.032	−0.006	0.031	−0.095	0.020	−0.007	−0.005
	(0.125)	(0.030)	(0.111)	(0.024)	(0.143)	(0.028)	(0.115)	(0.022)
% of time did not use contraception	0.028*	0.004	0.007	−0.004	−0.014	−0.002	0.000	−0.005*
	(0.015)	(0.004)	(0.013)	(0.003)	(0.016)	(0.004)	(0.015)	(0.003)
% of time did not use a condom	0.016	0.006	0.023	−0.001	−0.004	0.001	−0.019	−0.003
	(0.022)	(0.004)	(0.018)	(0.003)	(0.017)	(0.004)	(0.018)	(0.003)
Became pregnant	0.285*	0.049	−0.133	−0.012				
	(0.154)	(0.031)	(0.095)	(0.021)				
Had an abortion	0.237	−0.012	−0.353	−0.049				
	(0.293)	(0.058)	(0.220)	(0.048)				
Had an abortion or miscarriage	0.386**	0.065	−0.127	−0.026				
	(0.166)	(0.041)	(0.168)	(0.032)				
Gave birth	0.360**	0.004	−0.140	−0.003				
	(0.172)	(0.041)	(0.125)	(0.024)				
Caused a pregnancy					−0.031	−0.099**	−0.012	0.046*
					(0.230)	(0.042)	(0.117)	(0.026)
Caused a pregnancy that led to an abortion					−0.053	−0.253**	−0.239	0.108*
					(0.413)	(0.112)	(0.272)	(0.058)
Caused a pregnancy that led to a birth					−0.043	−0.092	−0.030	−0.026
					(0.313)	(0.063)	(0.202)	(0.040)

See Table 3 notes

the behavior of whites and blacks in this gender–age group are quite different. In a weaker economy (higher unemployment rate): Whites are less likely to have any sex and non-contraceptive sex and are more likely to use a condom, whereas blacks have more sex, are more likely to have non-contraceptive sex, are less likely to use contraception and more likely to use a condom and to use any form of contraception. Consistent with these patterns, in a weaker economy, white 18- to 20-year-old males cause fewer pregnancies and fewer pregnancies leading to births, whereas black 18- to 20-year-old males cause more pregnancies. Hispanics have a significant estimate in these models for having any sex (counter-cyclical) and causing a pregnancy leading to an abortion (also counter-cyclical).

In Table 7, we present a comparison of the coefficient estimate on the overall state unemployment rate from the original model and the coefficient estimates on the

teenage state unemployment rate from similar models that replace the overall rate with the teenage rate. Using the teenage state unemployment rate produces mostly positive coefficient estimates (indicating behaviors leading to counter-cyclical fertility) and slightly lower levels of significance for 15- to 17-year-old females. The estimates are generally smaller, although that can partly be explained by a standard deviation that is about 3.5 times greater for the teenage unemployment rate than for the overall state unemployment rate. For the 18- to 20-year-old females, the outcome "had any non-contraceptive sex" is now negative and significant. For the two male samples, none of the coefficient estimates on the overall unemployment rate were significant for the full sample. However, for 15- to 17-year-old males, causing a pregnancy and causing a pregnancy that leads to an abortion are pro-cyclical, and for 18- to 20-year-old males, the amount of sex and causing pregnancies are counter-cyclical, which are consistent with the findings for blacks.

In Table 11 in the Appendix, we present a comparison of estimates on the unemployment rate for models that have clustering at the state-year level and models that have clustering at the individual level. We use the three samples, from the results described above for Tables 3, 4, 5 and 6, that had the greater levels of significance: all 15- to 17-year-old females and 18- to 20-year-old white and black males. In general, there are fewer estimates that are significant when clustering at the individual level, but the patterns generally remain. The estimates for 18- to 20-year-old black males maintain their significance levels in the new models.

5 Discussion

In summary, we find that: (1) 15- to 17-year-old females have counter-cyclical pregnancies and behaviors contributing to pregnancies; (2) these behaviors and outcomes have hardly any relationship with the economy when estimated for 18- to 20-year-old females and 15- to 17-year-old males for the pooled sample or individual racial/ethnic groups; (3) although these behaviors/outcomes for the pooled sample of 18- to 20-year-old males have no relationship with the economy, evidence indicates that these behaviors/outcomes leading to pregnancies and births are pro-cyclical for whites and counter-cyclical for blacks in this age–gender group.

The design of our study is different from Levine's (2001) individual-level analysis in that we use more recent data, more outcomes, a sample of all teenagers rather than a sample of high school students, and a more general economic measure—the state unemployment rate rather than the state teenage employment–population ratio. Still, the results for the 15- to 17-year-old females are consistent with Levine's (2001) general finding of behaviors leading to counter-cyclical fertility. However, the results for 15- to 17-year-old males are different, and the results for the 18- to 20-year-old male are also different, although the latter represents an older cohort than Levine's sample of high school students.

The findings of counter-cyclical pregnancies and behaviors contributing to pregnancies for 15- to 17-year-old females and no similar pattern for older females could be the result of several factors. For the 15- to 17-year-old females, the standard economics argument would be that the substitution effect outweighs the income

effect. In other words, the lower opportunity cost of the time it would take to have and raise the child is more important than the greater difficulty teenagers would have affording to have and raise a child. Under this theory, the effect of the opportunity costs changes more than the effect of changes in affordability for the younger females, but not the older females. But this may be an incomplete story. It could be that, in weaker economic periods, because there are fewer role models working or in what they would consider "decent" jobs, teenage females develop perceptions of not having great career opportunities. This would reduce the cost of limiting their human capital, which reduces the cost of having a child. This would likely be more of a factor for females in the younger sample, as they would more likely still be in high school. In addition, the more extensive sexual activity in weak economic periods may be responses to stress and may be due to having more unsupervised time and generally more time on their hands given that they are less likely to be working. Again, the unsupervised-time effect could be more applicable to the 15- to 17-year-old females, who are more likely to be living with parents than 18- to 20-year-olds.

Our results suggest strong differences across race for 18- to 20-year-old males. For white (non-Hispanic) males, the estimates on the unemployment rate suggest that this group is less likely to have non-contraceptive sex, is more likely to use a condom, cause fewer pregnancies, and fathers fewer children when the economy is weaker. In contrast, when the economy is weaker, black males are more likely to have non-contraceptive sex, less likely to use contraception and a condom, and more likely to cause a pregnancy. Our results are not directly informative on the reasons for these stark differences. Earlier in the paper, we gave reasons for why we might see counter-cyclical or pro-cyclical behaviors/outcomes associated with fertility. These results suggest that different forces may be affecting black versus white teenagers and that further attention should be paid for what might explain why the economy would have opposite effects on these behaviors for whites and blacks.

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Appendix

Data description

This part of the Appendix describes how we created the fertility-related behavior/outcome variables.

Sexual activity and contraception variables

For both males and females, we construct variables for sexual activity and (lack of) contraception use based primarily on three questions from the survey: (1) "About how many times have you had sexual intercourse since the last interview?"; (2) "Thinking about all the times that you have had sexual intercourse since the last

interview, how many of those times did you or your sexual partner or partners use any method of birth control, including a condom?"; and (3) "About what percentage of time have you and your partner used a condom?" Other lead-in questions were needed to separate nonresponses from no activity. The 2002 and 2003 surveys required an additional variable. An indicator for whether the person used a condom in every sexual encounter superseded the question on how often the person used contraception.

The first two outcomes for *whether had any sex* and *the number of times the person had sex since the last interview* (or in the past 12 months for 1997) is based directly from the first question. The *number of times the respondent had non-contraceptive sex since the last interview* is calculated as the difference between the answers to the number of times the respondent had sex and the number of times the respondent had used birth control. We excluded from the contraception models a few cases in which there were more instances of "used birth control" than "had sex." The variable for *whether had any non-contraceptive sex* is constructed from this variable. The variable for *the percentage of time the respondent did not use birth control*, for those who had any sex, is constructed by dividing the number of times the person had non-contraceptive sex by the number of times the respondent had sex. Sen (2002) uses both of these measures for contraceptive use in an analysis of how alcohol affects sexual behavior. These variables apply for both males and females and are available starting in the first round in 1997. The variable for the *percent of time the respondent did not use a condom* comes straight from the survey.

Questions about sexual behavior are often sensitive. To address expected nontrivial nonresponse, the NLSY-97 uses follow-up questions. "Refusals" and "I don't knows" to the numeric question on the number of times the respondent had sex was followed by a bracketing question. While nonresponse to the initial question on the number of times the respondent had sex ranged from 6 to 12%, about 60 to 70% of the initial nonresponders, depending on the year, answered the bracketed question. For the contraception question, the follow-up question asks about the estimated percent of time the respondent used birth control. Exploiting these follow-up questions, we include in our analyses both the numerical answers and the follow-up answers. For the bracketed answers for the level of sexual activity, we use the mid-point of the range. For the highest bracketed category of "201 or more" for the amount of sexual activity a person engages in, we use a value of 250. For non-contraceptive sex, we impute the value for nonresponders based on the number of times they had sex and the bracketed value for the percent of time they used birth control.

Pregnancies, abortions, and births

For pregnancies, abortions, and births, we create different outcomes for males and females because of differences in the type of question asked of males and females and differences in their knowledge of whether a pregnancy or abortion occurred. It is important to identify the timing of the decisions and outcomes because we need to assign these decisions/outcomes to specific periods to match the economic data. Unfortunately, the lack of specificity and the lack of timing questions in some of these variables will cause some inaccuracies in our data, especially for males. The variables used for these outcomes have a surprisingly small percentage of

Table 8 List of all explanatory variables used in all models

Explanatory variables
Average unemployment rate between interviews
Year dummy variables
State dummy variables
Average of monthly maximum AFDC benefits since the last interview
Average of monthly indicators since the last interview of Medicaid funding restrictions for abortions
Average of monthly indicators since the last interview of parent notification laws for abortions among minors
Average of monthly indicators since the last interview of mandatory delay for abortions among minors
Average age between interviews
Average age between interviews squared
Time since last interview
Race–ethnicity dummy variables: White, Black, Hispanic ("other" is the excluded category)
Dummy variables for who was present at time of interview: a parent, a friend, a child, an other relative, another person ("no one present" is the excluded category)
Dummy variables for living in a central city and living in an MSA ("living outside an MSA" is the excluded category)
Mother's education: dummy variables for having a high school diploma, having a college degree, and having missing educational attainment (in which case, we assign 0 to the other covariates)
Father's education (the same as for mother's)
Which parents the respondent lived with at age 12: dummy variables for: "both biological parents," "just one biological parent," and "one biological parent along with one other parent" (with "neither biological parent" the excluded category)
Number of full brothers
Number of older brothers
Number of full sisters
Number of older sisters
Responding parent lived with his/her parent(s) for at least 3 months since the birth of the oldest child; missing indicator for this variable (with main variable set to 0 if missing)
Mother's age at first birth (and missing indicator)
Missing mother's age of first birth
Mother's age at respondent's birth (and missing indicator)
Missing mother's age at respondent's birth
Parent lived with one of his/her parents since the oldest child's birth (and missing indicator)
Parent received government aid since the oldest child's birth (and missing indicator)
Parent had serious health problems since the oldest child's birth (and missing Indicator)

Table 9 Sample sizes for Tables 3 and 4

	15- to 17-year-old females				18- to 20-year-old females			
	All	White	Black	Hispanic	All	White	Black	Hispanic
Had any sex	9,785	4,743	2,650	2,053	8,752	4,285	2,388	1,750
Log of # times had sex	3,567	1,761	1,057	661	5,848	2,956	1,603	1,152
Had any non-contraceptive sex	9,774	4,735	2,562	2,030	8,745	4,258	2,382	1,764
Log of # times had non-contraceptive sex	1,535	730	445	323	2,419	1,082	687	598
% of time did not use contraception	3,543	1,753	1,048	655	5,840	2,953	1,599	1,151
% of time did not use a condom	3,142	1,560	903	599	5,839	2,949	1,601	1,152
Became pregnant	8,304	3,943	2,162	1,710	9,379	4,538	2,548	1,886
Had an abortion	7,213	2,306	1,309	692	8,508	3,647	1,944	1,488
Had an abortion or miscarriage	9,939	4,678	2,545	1,951	9,286	4,387	2,319	1,666
Gave birth	8,251	3,393	2,085	1,673	9,341	4,401	2,508	1,891

Table 10 Sample sizes for Tables 5 and 6

	15- to 17-year-old males				18- to 20-year-old males			
	All	White	Black	Hispanic	All	White	Black	Hispanic
Had any sex	10,159	5,079	2,655	2,092	9,097	4,600	2,353	1,803
Log of # times had sex	3,885	1,620	1,378	824	5,707	2,763	1,639	1,189
Had any non-contraceptive sex	10,136	5,071	2,598	2,023	9,084	4,584	2,365	1,832
Log of # times had non-contraceptive sex	1,478	617	464	378	2,240	1,034	632	553
% of time did not use contraception	3,809	1,602	1,331	811	5,698	2,760	1,638	1,184
% of time did not use a condom	3,379	1,443	1,178	706	5,702	2,760	1,639	1,187
Caused a pregnancy	6,049	2,605	1,485	1,043	9,374	4,604	2,432	1,856
Caused a pregnancy that led to an abortion	4,238	394	810	695	8,267	2,939	1,746	1,025
Caused a pregnancy that led to a birth	5,206	920	1,226	735	9,096	4,208	2,311	1,613

Table 11 Comparison of coefficient estimates on the unemployment rate from models using clustering at the state-year level versus the individual level

	Females 15–17		White males 18–20		Black males 18–20	
	Cluster at state-year level	Cluster at individual level	Cluster at state-year level	Cluster at individual level	Cluster at state-year level	Cluster at individual level
Had any sex	0.144**	0.144*	−0.124*	−0.124	0.100	0.100
	(0.064)	(0.081)	(0.074)	(0.095)	(0.155)	(0.167)
Log of # times had sex	−0.010	−0.010	−0.051	−0.051	0.227*	0.227*
	(0.074)	(0.084)	(0.086)	(0.092)	(0.117)	(0.138)
Had any non-contraceptive sex	0.186**	0.186**	−0.190**	−0.190*	0.420***	0.420**
	(0.081)	(0.093)	(0.080)	(0.114)	(0.161)	(0.192)
Log of # times had non-contraceptive sex	0.008	0.008	−0.016	−0.016	−0.028	−0.028
	(0.125)	(0.130)	(0.157)	(0.176)	(0.207)	(0.241)
% of time did not use contraception	0.028*	0.028	−0.022	−0.022	0.068**	0.068**
	(0.015)	(0.019)	(0.018)	(0.021)	(0.027)	(0.030)
% of time did not use a condom	0.016	0.016	−0.044*	−0.044*	0.063***	0.063**
	(0.022)	(0.023)	(0.023)	(0.025)	(0.023)	(0.028)
Became pregnant	0.285*	0.285*				
	(0.154)	(0.167)				
Had an abortion	0.237	0.237				
	(0.293)	(0.330)				
Had an abortion or miscarriage	0.386**	0.386*				
	(0.166)	(0.211)				
Gave birth	0.360**	0.360*				
	(0.172)	(0.196)				
Caused a pregnancy			−0.278*	−0.278	0.471**	0.471**
			(0.148)	(0.178)	(0.196)	(0.233)
Caused a pregnancy that led to an abortion			−0.348	−0.348	−0.191	−0.191
			(0.372)	(0.385)	(0.545)	(0.586)
Caused a pregnancy that led to a birth			−0.658**	−0.658*	0.415	0.415
			(0.318)	(0.340)	(0.271)	(0.337)

See Table 3 notes

nonresponses—typically less than 1 and 0% in some years for females and between 0 and 3% for males. First, we discuss the outcomes for females.

For pregnancies, our goal is to determine which intervals between interviews the respondent was pregnant. We assign the female respondent as having *had a pregnancy* begin in the period since the last interview if either: (1) she was pregnant at the time of the interview, (2) she had at least two pregnancies since the last interview, or (3) she had at least one pregnancy since the last interview and was not pregnant at the time of the last interview. With this measure, we may miss some pregnancies that are not known about at the time of an interview. For example, someone may have become pregnant 2 weeks before the 1998 interview and not known about it at the time of the interview. Therefore, in the 1999 interview, they did not have a pregnancy that began since the 1998 interview and may not count the one that started before the previous interview. These data start in the 1998 round.

For abortions, we use questions on the outcomes of each pregnancy the respondent had since the last interview or in the past year. We create a dichotomous indicator for whether the respondent *had an abortion* since the last interview. This variable is available starting in the 1998 round.

The birth data present a challenge for determining when the decisions are made. Having a child is typically the result of certain decisions on the intensity of preventative measures at the time of conception point and, possibly, a continuous set of decisions throughout the pregnancy to keep the child or abort, and all these decisions could depend on the economy. Thus, the decisions would carry over from one interval (between interviews) to the next interval if a woman were pregnant at the time of the interview.

Our strategy is to focus on the economic conditions at the time of conception. It would be more ideal to consider the time of conception through the first trimester for the period in which the decisions are made. However, we cannot identify the exact date of conception. Instead, we can determine whether the conception occurred since the last interview or before the last interview based on two questions: one on births from pregnancies since the last interview and one on births from previous pregnancies. If a female had a birth from a pregnancy since the last interview, we code her as having *given birth*. If she had a birth from a previous pregnancy, then we code her as having *given birth* (or technically, made the decision to give birth) in the previous period—i.e., in the period *before* the last interview. We use data starting in the 1998 round for this outcome because the 1997 question about pregnancies is not under a specified period.

For males, we use a different set of questions specific to males. For pregnancies, we use a question on whether the male *caused a pregnancy* since the last interview. Of course, it is possible that some males are not aware that they caused a pregnancy. "Refusals" and "Don't Knows" account for roughly 1% of all responses—mostly, they were "Refusals."

Subsequent questions asked about whether any of these pregnancies ended in an abortion and whether any ended in a live birth. From these questions, we create dichotomous indicators for having *caused a pregnancy leading to an abortion* and having *caused a pregnancy leading to a birth*. Nonresponses occurred in between 0 and 3% of the answers to these questions. These questions on pregnancies, abortions, and births for males are available starting in the 1999 survey round.

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