The Impact of Subsidized Birth Control for College Women: Evidence from the Deficit Reduction Act

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Abstract

This paper uses a unique natural experiment to investigate the sensitivity of American college women's contraceptive choice and sexual behavior to the price of prescription birth control. With the passage of the Deficit Reduction Act of 2005, Congress inadvertently and unexpectedly increased the effective price of birth control pills ("the Pill") at college health centers more than three-fold, from $5 to $10 a month to between $30 to $50 a month. Using two different data sets, we employ multiple empirical strategies—including interrupted time-series, quasi-difference-in-differences, and fixed effects—for identification, and we find consistent results across data sets and methodologies. Our benchmark estimates show that this policy change reduced use of the Pill by at least 1.5 percentage points, or 3 to 4 percent, among all college women. For college women who lacked health insurance or carried large credit card balances, the decline was two to three times as large. We also find modest but significant decreases in frequency of intercourse and the number of sex partners, suggesting that some women may be substituting away from sexual behavior in general, although women who remain sexually active are somewhat more likely to use no contraceptive method at all. Finally, supplementing our data with a unique survey on how and where birth control prescriptions are filled, we use a back-of-the-envelope calculation to bound the price elasticity of Pill usage between -0.09 and -0.04. To the extent that this elasticity captures the population extended prescription birth control coverage by the Affordable Care Act, increases in birth control use are likely to be modest.

JEL: I13, I14, I18, I23; J13

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Introduction

The birth control pill, or simply, the Pill, is the most popular form of contraception on college campuses in the United States. According to the American College Health Association, nearly 40 percent of college women use the Pill to prevent pregnancy, and of those women using any form of contraception, 61 percent use the Pill. In recent years, research has increasingly shown how availability of the Pill, especially during college, led to lasting impacts on women's human capital investments, career choices, and wages (Goldin and Katz 2002; Bailey 2006; Bailey, Hershbein, and Miller 2012). Yet, despite this importance, remarkably little is known about college women's sensitivity to price of the Pill, the extent to which they treat it as a substitute or complement to other forms of birth control, and how its use affects sexual behavior. With the Affordable Care Act set to take full effect in 2014, including its provision for prescription contraception with no co-pay, understanding the shape of college women's demand curve for the Pill is of considerable policy interest and importance.

This paper leverages a natural policy experiment to examine the effects of a dramatic change in the price of prescription birth control at college campuses on contraceptive choice and sexual behavior. Prior to 2007, pharmaceutical companies sold prescription contraceptives to college health clinics at deep discounts in order to attract brand loyalty among young consumers and receive tax deductions. As a result, students could obtain inexpensive birth control, and colleges earned a bit of revenue by adding a small markup to help support other health initiatives around campus (Wasley 2007). This arrangement ended on January 1, 2007, when the Deficit Reduction Act of 2005 (DRA) went into effect, eliminating the incentives for pharmaceutical companies to sell drugs below retail price to all but a limited list of organizations, college health clinics not included. Consequently, the typical price of prescription birth control jumped from between $5 and $10 a month to between $30 and $50 a month on college campuses around the country. College health professionals worried that the change would lead to fewer women using the Pill, fewer well-woman visits (that could have lasting impacts on health), more use of emergency contraception, and more unintended pregnancies (Chaker 2007, Wasley 2007).

Exploiting the exogenous price change from the DRA and two complementary data sets on contraceptive choice and sexual behavior, we find that the policy reduced use of the Pill by *at least* 1.5 percentage points, or 3 to 4 percent, for college woman overall. For college women who lacked health insurance or carried large credit card balances, the decline is two to three times as large. Additionally, we find small but significant decreases in the fraction of women who have had intercourse, and the number of sex partners, suggesting that some women may have substituted away from sexual behavior in general. We also supplement these estimates with a unique survey on where college women actually obtain their birth control, allowing us to bound the price elasticity of demand of the Pill between -0.09 and -0.04.

The paper proceeds as follows. We first describe the history of price subsidies for prescription medication at college health centers and the federal policy that ended these subsidies in 2007. The following section briefly reviews the experimental and quasi-experimental literature on the price sensitivity of birth control and family planning methods, highlighting the dearth of such research in a relatively affluent, developed country context. We then develop a simple theoretical framework that allows us to illustrate how the comparative statics from a price change might affect different margins of behavior (e.g., method of birth control, sexual frequency, partner status) and by magnitudes that vary across income levels. Sections V and VI discuss the two datasets we employ in our empirical analysis, the National College Health Assessment and the National Survey of Family Growth, and the empirical strategies we use to identify the effects of the policy change. We next review our results, including several robustness checks to confirm the validity of our approach, before turning to our unique field survey of where college students obtain their prescription contraceptives, and how we use our estimates and these data to bound the price elasticity of the Pill for college students. Finally, we conclude.

II. Policy Background

President Bush signed the Deficit Reduction Act of 2005 (DRA) into law on February 8, 2006. The law, which went into effect January 1, 2007, was intended to reduce overall spending on Medicaid by reducing government payments for unnecessary services and cracking down on Medicaid rebate claims fraud. One of its provisions (Title VI, Subtitle A, Chapter 1, section 6001, part (d)) abridged the list of organizations that could receive "nominally" priced drugs from pharmaceutical companies.[1] "Nominal" pricing allows the pharmaceutical companies to provide low cost drugs to clinics and organizations serving low-income populations without decreasing the "best price" paid by Medicare and Medicaid[2]. Prior to the DRA, college health clinics were able to purchase contraceptives at the significantly lower nominal price, but since they were not explicitly named as eligible for nominal pricing in the Act, starting in January 2007, they were required to pay the full wholesale price for all drugs. This had the effect of raising the price of contraceptives on college campuses from around $5 to $10 for a month's supply to between $30 and $50 (Rooney 2007). Because this specific provision was buried in the language of the bill, most college clinics did not hear of the change until an American College Health Association bulletin in December, 2006, less than a month before the law went into effect. Despite the late notice, many schools were able to stockpile reduced price contraceptives that they could continue to sell to their students until supplies ran out. The University of Michigan, for example, was able to purchase enough to last until mid-2008, though other schools ran out much sooner (Rooney 2007). The effect of the Act went beyond just birth control prices; pharmacies at several college campuses, including Duke and Florida State, were forced to close after losing the revenue from their small markup over the nominal price on oral contraceptives (Cho and Reddy 2009).

Importantly, this provision was both accidental and unexpected. Many legislators have said the omission of college health clinics was unintentional and a result of last minute word changes in conference committee (Davey 2007). Organizations that promote the health of college students and access

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[1] As part of the earlier Omnibus Budget Reconciliation Act of 1990, certain organizations—including non-profit health centers at college campuses—could buy prescription medications from pharmaceutical companies at a "nominal price," without affecting the price Medicare and Medicaid paid for the drug.
[2] The "best price" is generally the lowest price offered to any commercial (non-governmental) customer, excluding nominal prices. This price is used to determine the manufacturer rebates owed to state Medicare and Medicaid agencies.

to family planning such as the American College Health Association and Planned Parenthood were caught unaware and began lobbying efforts to reverse the provision only several months *after* it had gone into effect (Rooney 2007, Davey 2007). They were not successful until the “Affordable Birth Control Act” was introduced into the 2009 Omnibus Spending Bill and took effect in March of 2010. Consequently, prices for prescription drugs, including hormonal birth control, at college health centers were elevated for approximately a three-year period from 2007 to 2010.[3]

The price change is clearly evident in the Medical Expenditure Panel Survey (MEPS), which collects detailed information from households about their medical expenses, including prescription birth control. Figures 1A and 1B provide the mean and median prices paid for prescription birth control, excluding emergency contraception, from 2002 to 2008 by student status. Though the prices track very closely until 2007, they diverge sharply in 2008, when the price students pay overtakes that of non-students.

The Deficit Reduction Act of 2005 provides a nearly ideal natural experiment through which to investigate college women’s price sensitivity to the Pill, as it caused a large, exogenous increase in the cost of the Pill at campus health clinics. The magnitude of the shock, a greater than three-fold increase in price, is an important aspect of our research design for two reasons. First, much of the extant literature on the price elasticity of contraception, described below, has tended to find small or zero estimates for moderate price changes, so a large price shock might be necessary to find a sizable effect empirically. Second, because we do not directly observe in our data *where* college women obtain their method of birth control, our empirical design is *intention to treat* in that the price increase is expected to affect only a subset of women in our sample (those that receive prescription birth control from college health centers). A larger price change increases the power of our research design. Furthermore, because the price change was exogenous, it can be used as to assess the impact of Pill price among college women on a variety of

[3] It is not clear how quickly or how many pharmaceutical firms reinstituted nominal pricing at college health centers after the law passed, so elevated pricing may have continued to a degree.

social and educational outcomes, including substitution to other, possibly less effective forms of birth control, and changes in sexual behavior.

III. Literature Review

While the leading method of contraception among young women in the United States, especially among women attending college, is the birth control pill,[4] few studies have examined the responsiveness of Pill use to changes in price in the U.S. setting. In part, this is because causal identification is typically difficult, with little source of exogenous change. The literature consists mainly of studies conducted in developing countries. Some studies take a non-experimental, cross-sectional approach (Akin and Schwartz 1988, Schwartz et al. 1989) and find use of contraceptives, including the Pill, to be relatively insensitive to small changes in price. Jensen et al. (1994) finds similarly inelastic demand for contraceptives for their overall sample in Indonesia, but substantially more elastic demand among poor households, implying that price elasticities likely vary by income and credit constraints. All these studies, however, rely on self-reported price estimates and include travel and time costs and so may not reflect the effects of purely monetary price changes.

Others studies use an experimental approach, randomly altering the price of condoms and oral contraceptives (Gadalla 1980, Lewis 1986, Cernada 1982, Ciszewski and Harvey 1995, Harvey 1994, among others), and generally find contraceptives to be relatively price inelastic. Ciszewski and Harvey (1995), in particular, look at the effects of an increase in the prices of certain, socially marketed condoms and oral contraceptives in Bangladesh and find significant decreases in sales of those contraceptives. In their review, however, Janowitz and Bratt (1999) show increases in overall demand for both condoms and the Pill in the treatment regions following the price increase, suggesting that people had simply

[4] According to the 2006–2008 National Survey of Family Growth, 21 percent of American women aged 15 to 24 were currently using the Pill; of women this age who were using any form of contraception, 50 percent used the Pill (Mosher and Jones 2010). In our sample of college women, 40 percent were currently using the Pill or had the last time they had intercourse, and of those using any form of contraception, 61 percent used the Pill.

substituted other brands in place of the more expensive, socially marketed condoms and oral contraceptives. Little research has attempted to assess the substitution between different contraceptive choices following price changes; this constitutes a major gap in the literature, which this paper begins to address.

Other studies examine how legal access to the Pill in the late 1960s and early 1970s changed American women's fertility, human capital investment, and labor force decisions (Goldin and Katz 2002; Bailey 2006, 2010; Bailey, Hershbein, and Miller 2012), and show large, statistically significant differences in Pill use between states where access was legal and states where it was not. Since changes in the legality of the Pill can be considered changes in the economic cost of use, if not a change in monetary cost, these findings suggest that women who faced a higher cost to obtain the Pill were substantially less likely to use it.[5]

In a more recent American context, Kearney and Levine (2009) examine the effect of increasing the income eligibility threshold for Medicaid services, which effectively reduces the price of family planning services for newly covered women, on contraceptive use. They find that new Medicaid eligibility reduced the probability of not using birth control at last intercourse by 5 percentage points among non-teens. However, the eligibility change not only reduced the price of contraceptives, it also reduced the price of health services more generally, making it difficult to disentangle how much of the effect is due to a price change and how much is due to greater access to or knowledge about contraception. In contrast, the source of identification in this paper is a price change for a specific form of birth control—prescription-based birth control—that is independent of family planning or health services.

Additionally, Levine (2000) provides evidence that American teenagers change both their sexual behavior and birth control choices in response to changes in the price of pregnancy, measured by labor market conditions, AIDS incidence, welfare benefits, and abortion restrictions. While changes in the price

[5] Such an economic cost could comprise the psychic cost of breaking the law, stigma for opposing a social norm, or search costs in finding a provider source.

of contraception are not the same as changes in the price of pregnancy, this suggests that the response of college women to the exogenous change in prescription contraceptive prices might be to alter their sexual habits in addition to or in place of changing their contraceptive strategy.

IV. Theoretical Framework

To assess the impact of a change in the price of birth control on women's sexual behavior and contraceptive choice, we develop a flexible theoretical framework. Suppose that a woman has utility over a composite consumption good, *x*; sexual pleasure, E; and her risk of pregnancy, *P*, which is a bad. Sexual pleasure itself is a function of three choice variables: relationship status, $r = 1,2,\ldots,R$; frequency of sexual activity, $s = 1,2,\ldots,S$; and choice of birth control, $k = 1,2,\ldots,K$. Similarly, risk of pregnancy depends on two of these choice variables, *s* and *k*. The woman's utility can thus be expressed as $U = u(x, E(r, s, k), P(s, k))$.

We make the reasonable assumptions that $P(1,.) = 0$, where $s = 1$ corresponds to no sexual intercourse (abstinence), and that $P(\ )$ is nondecreasing in *s* for any *k*; that is, more frequent sexual activity cannot decrease the chance of pregnancy no matter what birth control method is chosen. Additionally, we assume birth control methods can be ranked in (ascending) order of effectiveness in reducing $P(\ )$ and that this ordering is independent of sexual frequency.[6] For $E(\ )$, we remain completely agnostic and allow the determinants of sexual pleasure to depend freely on the three inputs.[7]

While the choice of relationship status and sexual frequency do not have a direct financial cost, the composite good and birth control choice do. Normalizing the price of *x* to unity, the woman's problem can be expressed as:

$$Max_{x,r,s,k}\, u(x, E(r, s, k), P(s, k)) \quad s.t. \quad x + p_k \leq M, \qquad (1)$$

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[6] See Trussell (2007).
[7] Since *r*, *s*, and *k* are each drawn from finite sets, there are *R x S x K* possible values of E.

where M represents income and p_k is the cost of birth control method k. Substituting for x using the budget constraint yields

$$Max_{r,s,k}\, u(M - p_k, E(r,s,k), P(s,k)). \qquad (2)$$

This formulation shows the tradeoff between more effective, and presumably more expensive, birth control and reduced consumption of the composite good. Since r, s, and k are discrete, a woman chooses relationship status r^*, sexual frequency s^*, and birth control option k^* such that

$$u\big(M - p_{k^*}, E(r^*, s^*, k^*), P(s^*, k^*)\big) \geq u\big(M - p_k, E(r,s,k), P(s,k)\big)\ \forall\, r, s, k. \quad (3)$$

This framework has several characteristics of note. First, if the function $E(\quad)$ varies across women according to taste and biology, it is possible for women with the same income and facing the same prices to optimally choose different relationship statuses, frequencies of sexual activity, and methods of birth control. Second, the price sensitivity of the optimal birth control choice depends on the marginal utility of the consumption good and income. In particular, if $u(\quad)$ is concave in x, which is a standard assumption, then higher income women should be less sensitive to price than lower income women.[8] Third, a change in the price of birth control method k influences not only the optimal choice of birth control but potentially that of relationship status and sexual frequency as well (and, indirectly, the outcomes of sexual pleasure and pregnancy risk.) This last point is complex and merits discussion.

For sufficiently small price changes that do not cause a woman to switch birth control methods, relationship status and sexual frequency should also remain unchanged. This follows immediately from the weak axiom of revealed preference. In this case, the woman suffers a utility loss from lower consumption of the composite consumption good but does not otherwise alter her behavior. For larger price changes such that a change in birth control method is optimal, the woman must compare the payoffs

[8] A woman will switch birth control methods if and only if $F \equiv u(M - p_k, E(r,s,k), P(s,k)) - u(M - pk*, Er*,s*,k*, P(s*,k*)) > 0$ for some r, s, and k $\neq k*$. Taking the cross-partial derivative with respect to M and p_{k*}, however, yields $\frac{\partial^2 F}{\partial p_{k^*} \partial M} = u_{xx}$.

through $E(\ )$ and $P(\ )$ across the entire $r \times s \times k$ set. It is quite possible for the woman to find it optimal to switch birth control methods but maintain her relationship status and frequency of sex. On the other hand, a different birth control method may imply the original $\{r, s\}$ choices are no longer utility-maximizing and either or both may change. Without imposing more structure on the utility function, *how* they change is an open-ended empirical question.

As we are interested in an effective price increase for prescription birth control generally and the Pill specifically[9], however, we can make contextual comments. Since prescription methods are among the most effective in reducing the risk of pregnancy, women who switch methods are likely to choose less effective methods, increasing *P* unless *s* is reduced. In turn, if *s* is reduced, optimal relationship status can also change. Under the additional assumptions that *(a)* sexual pleasure increases in sexual frequency more in a partnered relationship than when single, and *(b)* that there is a threshold in sexual frequency below which being single is preferred to being with a partner, lower sexual frequency may induce a switch away from partnered relationships. This is shown in the panels of Figure 2. Suppose a woman optimally chooses *s**, the Pill, and being partnered, as shown in the first panel.[10] If the price of the Pill rises and the woman finds switching to condoms as her next best method, she reduces her sexual frequency to *s*** to offset the disutility from the higher risk of pregnancy of using condoms instead of the Pill. In the second panel, the woman still finds it optimal to be with a partner. However, if it is optimal for her to reduce her sexual frequency to *s**** (the third panel), perhaps because she is more risk averse regarding pregnancy, she finds it best to be without a partner. The exercise demonstrates only that these behavioral changes are *possible* and worth investigating empirically.

V. Data Sources

We use two main sources of data for our analysis, the National College Health Assessment

[9] In our data, between 80 and 90 percent of college women using prescription birth control use the Pill.
[10] *s**is bounded above because of the risk of pregnancy.

(NCHA) and the National Survey of Family Growth (NSFG). The NCHA is a large-scale survey of college students at participating colleges administered by the American College Health Association (ACHA). It has been conducted twice a year (the fall and spring semesters) since the spring of 2000 and asks a wide range of questions related to demographic characteristics, health, and risky behavior, including sexual behavior.[11] In particular, the surveys include questions on the method of birth control used at last sex and sexual activity over the last 30 days, as well as on a wide range of medical conditions, including sexually transmitted infections and pregnancy, and health-related academic difficulties over the last year. Between thirty and eighty colleges participate each semester, with many schools participating multiple times.

We restrict the data to include only 4-year colleges, as there are very few two-year colleges in the data and these colleges are much less likely to have full-service campus health clinics. Additionally, since not all institutions participate regularly in the NCHA, we restrict the sample to respondents at institutions that participated both before and after the policy change went into effect to reduce composition bias in our estimates. As institutions individually decide whether to participate in the survey (although the survey is administered to randomly selected students within schools), the NCHA is not nationally representative of all four-year colleges.

To explore the issue of representativeness, we compare our NCHA sample with four-year colleges from the Integrated Postsecondary Education Data System (IPEDS), a nearly complete universe of higher education institutions in the United States. Table 1 provides summary statistics from our NCHA sample, as well as the IPEDS sample and the subset of IPEDS restricted to only full-time students. The NCHA sample is younger than the full-time IPEDS sample, and substantially more white. NCHA also contains more schools from the West and fewer from the South and Northeast, as well as more large (over 10,000 students) schools than the IPEDS full-time sample. There are not significant differences in Pill

[11] We use the spring 2000 through spring 2008 survey waves. Beginning with fall 2008, a change in the survey instrument makes direct comparison with earlier waves difficult.

usage by school size or by region, so we do not believe this poses significant analytical concerns.

The NSFG is a nationally representative sample of women aged 15 to 44, only a small fraction of whom are currently enrolled in college. We use the 2006-2008 round of the NSFG, which has the unique and beneficial feature of being administered continuously from July of 2006 through December of 2008, thus spanning the policy change. The NSFG asks a wide range of questions related to fertility and family, including a retrospective contraceptive calendar that ascertains the contraceptive methods used each month over the 48 months preceding the interview. We define our treatment population to be women who are currently enrolled in school and whose highest level of education is at least part of one year of college.

We employ both data sets because they complement each other. The NCHA has the advantage of large sample sizes (on the order of 100,000 observations in most cases), providing sufficient power to detect small changes even among subgroups of women. However, because every woman in the sample is potentially affected by the policy change, there does not exist a natural control group other than college students before the policy change. We attempt to address this by comparing effects between large and small schools, as small schools are less likely to have on-campus pharmacies and thus less likely to have been affected by the price change, but this is an imperfect control at best. The NSFG, on the other hand, allows comparison with similarly-aged women who were not college-goers and thus would not be affected by the policy change, and even allows within-person comparisons through the monthly contraception method calendar. However, its sample size of roughly 7,500 women, less than 20 percent of whom are attending college, comes with the cost of sharply reduced precision.

It is important to note that since we cannot identify where women obtain their birth control, we are employing an intention to treat (ITT) analysis and our estimates represent a lower bound of the effect of the policy change on Pill usage among women who were obtaining birth control from campus health clinics.[12] This is because some women obtained birth control from other sources before the policy change

[12] Information on where students obtain birth control is surprisingly scant. One article (Cottrell 2007) reported that 10 percent of female students at American University obtained prescription birth control at the Student Health

and thus should not have been affected. Furthermore, even among women who were obtaining birth control from campus health clinics, the option to go elsewhere to obtain their contraception may mitigate against finding an impact. Planned Parenthood, in particular, is often used by college women, and the majority of their clinics were not affected by the DRA price increase.

VI. Empirical Methodology

Because the two data sets admit different comparison groups, our empirical methodology differs somewhat between them. For the NCHA data, we employ interrupted time-series and (quasi-) differences-in-differences designs. For the NSFG, we employ differences-in-differences and fixed effects designs. These specifications are described in detail below.

For all approaches, we define our treatment period to begin in fall (September) 2007. Our decision to begin the treatment period in the fall of 2007 reflects that the timing of the onset of the price increase varied by campus. Many colleges were able to stockpile nominally priced contraceptives in anticipation of the law, so that students were not faced with the retail prices until after those stocks ran out, typically in mid-2007 (Rooney 2007, Chaker 2007). Other college clinics had substantially smaller stocks, so the price increase took effect in early 2007. While this type of measurement error in the treatment period will tend to bias our results toward zero, we deal with this issue by omitting data from the first half of 2007, when treatment status is uncertain.[13]

NCHA

We estimate the effects of the DRA using one of the following regressions

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Center in 2007. If we assume 40 percent of female AU students use the Pill, in line with the NCHA average, this implies that 25 percent of Pill users obtained their pills on campus. We have fielded our own survey of university students to obtain a more accurate estimate of where college students fill their birth control prescriptions, discussed in section VIII.

[13] Relaxing this restriction to include the Spring 2007 wave as treated does not substantively change the point estimates but increases the standard errors.

$$Y_{ijt} = \alpha + treat_t\beta + \boldsymbol{X_{ijt}}\lambda + f_j + \kappa t + \varepsilon_{ijt} \qquad (4)$$

$$Y_{ijt} = \alpha + (treat_t \times D_j)\boldsymbol{\gamma} + \boldsymbol{X_{ijt}}\lambda + f_j + \kappa t + \varepsilon_{ijt} \qquad (5)$$

where Y_{ijt} is an outcome for person *i* at school *j* interviewed at wave/time *t*, $treat_t$ is a dummy for our treatment period (equal to one if *t* is Fall 2007 or Spring 2008 and zero otherwise), D_j is an indicator for whether a school is of a certain type, and $\boldsymbol{X_{ijt}}$ is a vector of individual demographic and behavioral covariates. The f_j terms denote fixed-effect dummies for schools and *t* is a linear time trend. Equation (4) is an interrupted time-series model, where the coefficient of interest, β, represents the deviation in trend in the outcome at the beginning of the treatment period. Equation (5) modifies this model to allow the effect of the treatment to vary across groups, D_j. Functionally, we base D_j on the school's size: whether student enrollment is greater or less than 5,000. Since smaller schools are less likely to have a campus pharmacy, there is less of a chance that students there are effectively "treated," making these schools a plausible comparison group. The coefficient vector $\boldsymbol{\gamma}$ thus represents the effect of the treatment relative to a base group (a "dosage" effect), and for this reason we call the specification in (5) quasi-differences-in-differences. These estimates represent a lower bound on the true treatment effect on the treated, since not all students were receiving their birth control from the college health clinic prior to the price change, and so not all students were subject to the "treatment" of the price change.

In some specifications, we include school-specific linear time trends ($f_j \times t$) to capture school characteristics that evolve over time and may have affected Pill use and other outcomes independently of the price increase, such as attitudes towards the Pill or trends in sexual behavior on campus. To allow for correlation in the error term among students attending the same school, we cluster standard errors at the school level.

NSFG

The NSFG data provide two avenues for examining the effects of the DRA using the panel sample from the contraceptive calendar. In this framework, an observation is now a person-month rather than a person, and the time index is not the interview month, but the month referenced in the contraceptive calendar. The definition of $college_{it}$ is now such that it equals one only for the months during which the woman is enrolled in college.[14] Because there are now multiple observations for each individual, we can employ both difference-in-difference and fixed effect models:

$$Y_{it} = \alpha + treat_t\beta + college_{it}\delta + (treat_t \times \ college_{it})\rho \ + \ \boldsymbol{X_i}\lambda + \kappa t + \ \varepsilon_{it} \quad (6)$$

$$Y_{it} = \alpha + treat_t\beta + college_{it}\delta + (treat_t \times \ college_{it})\rho \ + \mu_i + \kappa t + \ \varepsilon_{it}, \quad (7)$$

where Y_{it} is an outcome for person i interviewed in month t, $treat_t$ is a dummy for treatment status (equal to one if t is on or after September 2007 and zero otherwise), and all other variables are as previously defined. In (6) and (7), the coefficient of interest is the difference-in-difference estimate, ρ, on the interaction of treatment and college-going, which represents the change in the difference of the outcome (e.g. Pill use) for women enrolled in college, relative to non-college-going women. In (7), individual fixed effects, μ_i, replace the controls $\boldsymbol{X_{it}}$ from before. For heterogeneous effects, we run (6) and (7) on different subsamples of the data rather than impose additional interactions for ease of interpretation. For all NSFG models, standard errors are clustered at the PSU level.

Although all regressions with binary outcomes are run as linear probability models (using OLS), the results presented below are robust to specifying probit models and calculating average partial effects, as well.

VII. Results

A. Pill Use

Panel A of Table 2A presents the β coefficients on the treatment dummy from (4) with Pill use as the dependent variable, along with mean Pill use for reference. We have made the conscious decision to

[14] We determine that a woman was enrolled in college in month t if (a) she was enrolled as of the interview month, and (b) month t falls after she began college, assuming continuous enrollment. (That is, the interview month, less twelve times the number of years of college she had attained, falls before month t.)

code women who are not using the Pill and are not sexually active as 0, identical to women who are sexually active and not using the Pill, because the theoretical framework makes clear that sexual activity may be an important margin of response, which we explore explicitly below. We run regression (4) without any individual-level controls and with demographic controls (dummies for age, race, class, health insurance status, full-time student status, residence type, greek status, and credit card debt), both with and without school-specific linear time trends. We restrict the sample to schools that participated in at least two NCHA surveys prior to Spring 2007 and at least one after Spring 2007 to reduce composition bias caused by colleges that participated only once or twice. Additionally, we omit the Spring 2007 wave because of its uncertain treatment status.

We find consistently negative and statistically significant estimates of the change in Pill usage following the price change. These estimates imply that overall women reduced their use of the Pill by 1.7 to 2.0 percentage points, or about 4 percent, in response to the price increase. Across the columns in panel A, the treatment effect is remarkably consistent whether we include demographic controls or allow for school-specific time trends. However, the interrupted time series design does not provide the strongest identification, and it is possible an unobservable factor other than the price change is driving the result. Thus, panel B implements the specification in (5), where we allow the effect to vary by school size. Since very few small schools have campus pharmacies, we would expect the treatment effect to be much smaller at these schools. And, indeed, that is what we find. At large schools, those with enrollment greater than 5,000 students, the coefficient estimates are slightly larger than those in panel A; for small schools, on the other hand, the point estimates are uniformly close to 0.[15,16] An even stronger test of identification is presented in panel C, which replaces the linear time trend with a full set of time dummies. In this specification, we can no longer separately identify treatment effects for both large and small schools but

[15] Students at large schools are about 2.5 percentage points more likely to use the Pill than their counterparts at smaller schools, but this difference is accounted for by differences in observable demographics. Also, the assumption of common trending between school sizes cannot be rejected at 10 percent once demographic controls are included.

[16] The difference between school sizes is significant at 5 percent in the second column.

can instead estimate only their difference. These point estimates are quite close to the implicit differences in panel B, which is reassuring that linear trends do an adequate job in capturing secular variation.

While the NCHA data imply that the price changes induced by the DRA led to a small but significant reduction in Pill use among college women, the NSFG sample provides additional verification. Table 2B shows results from estimation of (6) and (7). The difference-in-difference estimate in the first row f shows a 3.7 percentage point drop in Pill use among college women relative to other women, while the fixed effects estimate is a 1.3 percentage point drop. Although noisy, given the much smaller sample sizes, these results are quite close to the NCHA numbers, as would be expected if non-college women were unaffected by a price change at college pharmacies. The second panel restricts the analysis to college women in order to align more closely with the identification strategy in the NCHA. The point estimate of -0.0170 in the first column is nearly identical to the corresponding estimate in Table 2A (panel A, column 2), as is the fixed effects estimate in the second column. That a different and independent data set yields the same point estimate under a similar identification strategy supports the validity of our results. In summary, the policy change led to a modest reduction in Pill use among all college women.

As mentioned earlier, however, not all college women are likely to have been equally affected by the price change. In particular, women with health insurance are unlikely to have been fully affected by the price increase. Many insurance plans cover birth control prescriptions, and while it may be less convenient to get birth control through private insurance, and there is an additional risk of parental disapproval if the claim goes on parental policies—which may dissuade some women from utilizing their insurance coverage(Chaker 2007, Cottrell 2007)—it remains an option for women with insurance. As a result, though the price of birth control is likely to have gone up for them (few insurance policies at the time covered prescription birth control with a $5 co-pay), the price change was probably less severe for women with insurance (Frey 2007). Women without health insurance, on the other hand, were more likely to face a binding price increase due to their much more limited set of low-cost birth control providers outside of the campus health center, primarily Planned Parenthood or Title X clinics, which may or may not be available in the area. For these reasons, we would expect a more pronounced impact among women lacking health insurance. The results of regression (5) with Pill use as the dependent variable by insurance status are reported in Table 3A.[17]

We find that the reduction in Pill usage is nearly three times as large among women without health insurance relative to women with health insurance (about 3.5 percentage points, compared with 1.3 percentage points) and the larger negative effect for uninsured women is robust to the inclusion of school-specific linear time trends. Unsurprisingly, women with health insurance have significantly higher rates of Pill usage overall. These effects for insured women represent a roughly 3 percent decrease in the fraction of women using the Pill, while the effects for uninsured women represent a 10 percent decrease in the fraction of women using the Pill. Looking at the results by school size, as in panel B, reveals similar but slightly larger effects at large schools. At small schools, on the other hand, there is no detectable effect for women with insurance, and while the effects for women without insurance are of comparable size to those at large schools, the estimates are exceedingly noisy. This issue carries over to the last panel, which again presents results with a full set of time dummies. The point estimates for the difference in treatment between large and small schools are quite close to zero, but the large standard errors—especially for women without health insurance—render them uninformative.

Table 3B, however, shows that students without health insurance are also more severely affected in the NSFG.[18] While the estimates for women with continuous health insurance cluster around 0 in both panels and whether we control for demographics or use individual fixed effects, the estimates for uninsured women are large, negative, and statistically significant. Indeed, the fixed-effects point estimates for both the difference-in-differences (relative to non-college women) and differences (among college

[17] We classify women who report they don't know whether they have health insurance, a relatively small group, as not having health insurance.
[18] It is worth noting that the question about insurance is slightly different between the two surveys. In the NCHA the insurance question is "Do you currently have health insurance?"; in the NSFG the question is "Have you had health insurance continuously for the last 12 months?" While the responses are likely to be highly correlated, they are not completely comparable.

women) are identical at -8.6 percentage points, which would be expected under a null treatment effect on non-college women. Although this estimate is more than twice as large as the NCHA estimate, differences in the insurance question on the surveys prevent them from being strictly comparable. Rather, we view it as strong additional evidence for heterogeneous treatment effects by insurance status.

We extend the analysis of heterogeneous treatment effects by income in Table 4, which presents the results of regression (5) with Pill use as the dependent variable and credit card debt as the heterogeneous treatment variable. Credit card debt can be thought of as a proxy for financial constraints; women with large credit card balances are more likely to be both lower income and more credit constrained and price sensitive than their peers without balances. Pill use decreased among women without any credit card debt by 1.2 percentage points but decreased by about 3 percentage points among those with positive debt, with even larger effects found among women with higher credit card balances.[19] When we stratify by school size, we find relatively little difference for students without debt. Among students with debt, on the other hand, there is a large difference stemming from effects for large schools similar to those found in panel A and strangely positive (and sometimes significant) effects for small schools. These positive results are something of a puzzle, although we note they are based on a relatively small sample (see Table 1).

In additional specifications not shown in a table, we have also checked heterogeneity by age[20] (NCHA and NSFG), parental education (NSFG), and family poverty (NSFG). We consistently find patterns of stronger negative effects among the lower socioeconomic groups. Together with the results above, a clear pattern emerges of women of financial disadvantage—who were the most likely to benefit from the subsidies at campus health centers—having strong and statistically significant reductions in their Pill usage after the policy change, while more advantaged women could better absorb the price increase.

[19] In results not shown in the table, the reduction in pill use is monotonically related to debt: Women with credit card balances between $1 and $2,000 reduced their use of the Pill by 2.3 percentage points, and women with over $2,000 in debt reduced Pill use by 4.6 percentage points.

[20] Given that the modal age to graduate college is 22, women over 23 are more likely to be graduate students or non-traditional students who are less likely to have parental support and more likely to be financially constrained.

For women without insurance and women with large amounts of debt, for whom the price increase is more likely to bind, we estimate Pill usage to have decreased between 5 and 10 percent. Although this implies a relatively small price elasticity for the Pill, consistent with the previous literature, it is clear the price elasticity is greater for vulnerable populations.[21]

B. Other Methods and Sexual Behavior

As explained in the theoretical framework, if college women are using the Pill less, they could also be changing their birth control choice and sexual behavior. Results for other birth control methods as dependent variables are reported in Table 5. Each column is a separate contraceptive method, and with the exception of the last, emergency contraception (the "morning-after" pill), they are mutually exclusive. For brevity, results from specifications that include school-specific time trends are suppressed (they are very similar). In general, there is little indication of substitution toward other methods. While the interrupted time-series coefficients (panel A) are mildly positive for non-prescription methods, they are not close to statistical significance, and they are not especially robust to a difference-in-differences strategy, as shown in panel B. If anything, the latter strategy suggests affected women *reduced* use of both the condom and other non-prescription methods, while slightly increasing reliance on no method at all. However, these estimates should be interpreted cautiously, as we have chosen to code the outcome variable as 0 for women who have not had sex. This coding particularly affects the estimate for the use of no method: among women who are sexually active, the point estimate (standard error) is 0.0054 (0.0027) in panel A and 0.0095 (0.0046) in panel B. This would suggest that the policy change increased the rate of unprotected sex among women who remained sexually active. Thus some of the pattern may be driven by a response along the sexual behavior margin, and this is investigated directly in Table 6.

The first panel shows a statistically significant reduction in the fraction of women who have ever

[21] Caution should be exercised in estimating an actual elasticity, as we do not observe the fraction of college women who received their birth control pills at college health centers before the policy change. We address this issue in the next section.

had sex of 1.4 percentage points (2.0 percent)—approximately the same magnitude as the reduction in Pill use. This reduction does not seem to extend as much to the intensive margin, as the reduction in sex within the last 30 days is a third the magnitude. The rest of the panel shows there were also reductions of about 2 percentage points each in the fraction that were in a serious relationship, had a male partner within the last 12 months, or had two or more male partners in the last 12 months. These results generally carry over to the difference-in-differences strategy in panel B. The notable exception is the share in a serious relationship, the coefficient of which changes from a statistically significant -0.0253 to an insignificant 0.0136. When we estimated this relationship separately by school size (as in panel B of Table 2A) we found negative effects for both small and large schools, with a greater magnitude at smaller schools. It is hard to say whether the effect on relationship status is simply spurious or whether an additional, unobserved factor affected smaller schools in the treatment period. Even remaining agnostic about this outcome, there is reasonable evidence that college women responded to the price change in prescription contraception by reducing sex altogether. Recall that the discrete choice framework highlighted how a rise in birth control prices could affect both the equilibrium frequency of sex and whether an individual stayed (entered) in a coupled relationship. In practice, it is not clear whether behavior more closely resembles what is shown in Figure 1C or what is in Figure 1B, but *s* clearly falls.

Overall, these results show that college women did reduce their use of the Pill in response to the price increase, and that the reductions were two to three times larger among lower income or credit-constrained women and women without health insurance. Additionally, we find that the largest behavioral response was not switching to other forms of contraception so much as a reduction in overall sexual behavior.

VIII. Bounding the Price Elasticity

As we have noted, our estimates of the effect of the price increase in prescription contraceptives at college health centers are intent-to-treat effects, since not all women assigned to the treatment regime were affected by the policy shift. An important limitation of our data is that we do not observe whether college women were filling their birth control prescriptions at university health centers (and thus would be subject to the policy change) or at a retail pharmacy, Planned Parenthood clinic, or elsewhere. In fact, to our knowledge, *no* large-scale survey has asked college women who use prescription birth control where they obtained it.[22] From a policy perspective, and for comparisons with experimental studies in developing countries (e.g., Schwartz *et* al. 1989; Ciszewski and Harvey 1995), such information is essential. For example, our intent-to-treat estimates, by themselves, do not indicate whether a large share of college women was only slightly affected or whether a relatively small share was significantly affected. That is, without knowing the denominator of the fraction of college women using birth control who obtain it from the university health center, we cannot speak to the treatment effect on the treated or calculate price elasticities of demand.

In order to fill this gap, we fielded a survey of 860 female students at a large, research university in the Midwest.[23] The approximately 30-question survey asked many of the demographic questions that appear in either the NCHA or NSFG (to allow for conditional comparisons), but focused on contraceptive methods. For prescription-based methods, women were asked both where prescriptions were obtained *and* where they were filled. As such, we can begin to answer the questions posed in the previous paragraph, albeit with two, nontrivial caveats. First, our survey was fielded at a single university that is not representative of all colleges and universities in the country: in particular, the students are almost exclusively of traditional age and disproportionately come from affluent families. Second, while it would have been preferred to survey students before the 2007 policy change, our survey was fielded in May of

[22] The more recent waves of the NSFG, including the one used in this study, do ask women where they obtained the *prescription* but not where it was *filled*. The MEPS data do have some information on where prescriptions are filled, but the "clinic" option combines walk-in/community clinics, Planned Parenthood offices, hospitals, HMOs, and university clinics together.
[23] The details of how the survey was fielded, sample sizes, and response rates can be found in the appendix. Appendix Table A describes characteristics of the sample.

2011, nearly four years afterward.[24] Thus, if the policy change affected where women acquired their birth control, the survey responses will be biased as estimates of the pre-DRA period. We discuss below how both of these issues affect our estimation.

The first four rows of Table 7 show the fraction of female students who have used prescription birth control while at college. Approximately 56 percent of our sample had, and 74 percent had among the sexually active.[25] Columns 3 through 8 stratify the sample by age, financial aid status, and whether the student has insurance that covers prescriptions. Students age 25 or older are more likely to have used prescription contraceptives, but this seems to be driven by a greater propensity to be sexually active. Women who lack prescription drug insurance coverage, on the other hand, are notably less likely to have used prescription contraceptives, even among the sexually active. Indeed, the bottom of the table shows that these women are by far the most likely to cite price as being an important determinant of where to fill a prescription for birth control.

The middle panels of the table show where college women obtain their prescription for contraception and where they fill that prescription. Nearly half of women get their prescription from an off-campus primary care physician, while about 40 percent do so from the university clinic. Surprisingly, few students in our sample go to off-campus clinics such as Planned Parenthood, but this may be a feature of the specific nature of our sample. Indeed, women who lack prescription drug coverage are twice as likely to use an off-campus clinic as women who have coverage, and they are also more likely to use the university clinic. Students on financial aid and those above age 24, who are less likely to be dependents of their parents, are also more likely to use the university clinic, suggesting that relative income plays an important role in obtaining prescription contraception. As for where women fill the prescription, the most popular choice by far is a stand-alone drug store or pharmacy, but the university clinic and pharmacy is second, used by 20 percent of women. Again, socioeconomic status matters, with older students, those on

[24] We thought about asking retrospective questions on birth control, but the timing is such that very few women would have been in college before the policy change.
[25] As in the NCHA data, some 90 percent of prescription birth control is in the form of the Pill.

financial aid, and those without drug coverage more likely to use the university pharmacy, although the difference is only a few percentage points and is generally not statistically significant.

If we were to assume that the 20 percent of sampled women who obtained their prescription birth control at the university pharmacy was a reliable estimate of the share of all college women nationally who did so before the 2007 policy change, *and* that these were the only group of women affected by the policy change, then we could calculate an average treatment effect on the treated (ATT) by dividing our baseline estimate from Table 2, panel A by 0.202 (Angrist and Imbens 1995). While the latter assumption of no spillovers from the policy change seems plausible, the former, as we have suggested, is problematic. Students at the university in our survey are financially much better off than the typical college student nationally, and the socioeconomic gradient in where students obtain their prescription contraception suggests that the 20 percent figure is likely too low for a national estimate. To gauge how much this compositional effect matters, we reweighted the data on the basis of race, age, class standing, financial aid receipt, and the education of parents to conform to the national average of students attending a four-year college or university in the 2008 National Postsecondary Student Aid Study. This changed the fraction using the university pharmacy from 0.202 to 0.244.

It is also unclear how fielding the survey in the spring of 2011 yields estimates different than what would have obtained had the survey taken place in 2006. Standard choice theory (and the relative importance of price and convenience shown in Table 8) predicts that the higher prices in the post-change regime would have induced some women to switch away from the university pharmacy and toward the next best substitute—possibly pharmacies in "big box" stores, which most closely resemble the cost and convenience attributes of the campus pharmacy. Thus, it seems reasonable that this bias, too, is downward, although the magnitude is hard to gauge.

For these reasons, we believe the 0.202 estimate is a lower bound for the fraction of all college students who obtained their prescription birth control from the campus pharmacy prior to the DRA. To get a plausible upper bound, we apply the adjustments for composition bias above and assume, as an extreme case, that the policy change caused fully half of students who had been filling their prescription at the campus pharmacy to switch providers. This yields an estimate of 0.488 (0.244/0.5). Using our (conservative) benchmark estimate from column 2, panel C of Table 2A, this means that the ATT is effectively bounded between −3.0 (−0.0145 / 0.488) and −7.2 (−0.0145 / 0.202) percentage points. Relative to the mean pill use rate of 0.418, the ATT is a 7 to 17 percent reduction. Furthermore, we know that the average price paid by college students for prescription birth control (relative to that paid by non-students) increased by $3.97 per month between 2007 and 2008 (see Figure 2).[26] If this price increase was driven entirely by campus pharmacies, then the effective price increase among the treated was between $8.14 and $19.65 per month ($3.97 / 0.202), which is roughly in line with prices tripling from a base of $7 to $8 (Rooney 2007). A back-of-the-envelope calculation shows that the price elasticity of demand is between −0.085 (−17/200) and −0.035 (−7/200) under a conservative 200 percent effective price increase. These elasticities would be halved if the price increase were 400 percent (quintupling).

Although crude, these numbers represent the first estimates in the literature of the price elasticity of demand for prescription birth control among college women in the U.S. With little doubt, this demand is price inelastic, with even the high end estimate still below 0.1 in absolute value for college women as a whole. Given the strength of the assumptions underlying these ATT and elasticity estimates, we are reluctant to quantify these statistics for the subgroups of college women elsewhere in the analysis; however, because location choice appears less sensitive to price or income than pill use itself, the ATTs and elasticities for less advantaged groups are almost certainly larger in magnitude than they are for all college women, although they are likely to still be quite inelastic.

IX. Conclusion

In this paper, we examine the effects of a large exogenous shock to the price of the birth control

[26] The increase is nearly identical if 2006 is used as the base year instead.

Pill on college campuses caused by the Deficit Reduction Act of 2005. Using two different data sources, the NCHA and the 2006-2008 NSFG, we find that the three-to-ten-fold increase in the price of the Pill reduced the use of oral contraception by about 1.5 to 2.0 percentage points (3 to 4 percent) among college women. These findings are consistent with previous literature that documents small price elasticities for contraception in other contexts. We also find evidence that the reduction in the use of the Pill was significantly stronger for women without health insurance, women with credit card debt, and older women—groups for whom the price increase was most likely to bind. Although there is some suggestive evidence of an increase in unprotected sex among women who remain sexually active, one of our more robust findings is that the price increase led to a reduction in sexual behavior overall, with affected women reporting a lower likelihood of having had sex and fewer sexual partners. The analysis of the NSFG data, including results not reported in the tables in this paper, returns broadly consistent estimates, increasing our confidence in the NCHA results.

Our findings suggest that the enactment of the Deficit Reduction Act and the consequent increase in the price of the Pill on college campuses had a modest but economically meaningful effect on the contraceptive choices of college women, primarily by reducing Pill usage in populations that are likely to be financially constrained. Because we do not observe where women in our sample obtain their birth control—and thus which women are directly affected by the price increase—our methodology estimates intention-to-treat effects on the entire population, and our estimates are lower bounds on the average treatment effect on the treated. In order to be more precise about the relationship between these two parameters, we fielded a supplementary survey of college students that specifically asked where they filled their birth control prescriptions. While far from ideal, the survey allows us to construct an independent measure of the denominator in the Wald estimator that relates our ATE to the ATT. When we make the standard assumptions in the treatment effects literature (Angrist and Imbens 1995), we estimate that the ATT is approximately four times the ATE, or that women who had been obtaining their birth control at campus pharmacies prior to the price change reduced their Pill use by roughly 12 percent.

It is likely that many more still used the Pill but switched to a more expensive provider, although we cannot investigate this directly due to data limitations.[27] Nonetheless, incorporating this information with mean pill use and data on the effective price change, we can bound the price elasticity of demand for Pill use among this population of college women as between -0.09 and -0.04, the first such estimates in the literature in the American context.

With provisions of the Affordable Care Act (ACA) having taken effect last year that require nearly all health insurance plans to cover contraceptives, including the Pill, without deductible or co-pay, *and* additional provisions that are likely to increase the percentage of young Americans with health insurance (the "mandate"), it is of direct and immediate policy interest how this effective decrease in the price of prescription contraception will affect use and related sexual behavior. To the extent that our estimates are relevant to the population affected by the ACA, we would expect a relatively modest increase in prescription contraceptive use, on the order of 10 percent, for a 90 percent price reduction.[28] In the coming years, we hope to investigate empirically the validity of this prediction.

[27] In interviews with campus pharmacy directors, we were told that some students switched their brand-name prescriptions for cheaper generics at the campus pharmacy, while others stopped using the campus pharmacy and went to drug stores or big box stores with pharmacies instead.
[28] Of course, already-contracepting women have their utility increased due to an income effect.

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Survey Appendix

With the cooperation of the university health services (of which the campus pharmacy is part) and the registrar's office, and in consultation with the university's institutional review board (IRB), we designed a 31-question survey intended for students of the university. (The survey instrument follows this appendix.) The survey was hosted electronically by Qualtrics, and students completed it via web browser.

Five thousand students enrolled at the university in May 2011 and who were at least age 18 were randomly drawn by the registrar's office and invited by email to participate in the survey. As an incentive, students completing the survey were entered into a drawing to win two $50 gift certificates from Amazon.com. The initial email was sent on May 3, 2011, and follow-up emails were sent on May 11 and May 19 reminding those who had not yet participated about the survey. The survey was live throughout the month of May.

Of the 5,000 students invited, 1,439 (29 percent) began the survey and 1,329 (27 percent) completed it. Of these 1,329 completers, nearly all provided key demographic information on gender, race, and class standing; only 17 did not. Our effective sample thus consists of 1,312 students, among whom 860 (66 percent) are women and 452 (34 percent) are men. As the sample frame was a simple random sample and was not stratified, response rates were not proportional to the enrolled universe of students. Using data from the university and the IPEDS database, we constructed two types of sampling weights: one based on sex-race-class cells and one based on (marginal) age categories.[29] The weights were created such that the product of the in-sample cell proportion and the weight equaled the universe proportion. A final weight was created by taking the product of the sex-race-class weight and the age-group weight. The statistics shown in Table 11 use these weights. As our focus is on women, we present in Appendix Table A selected summary statistics for the women sample, both weighted and unweighted.

Appendix Table A

	Unweighted Percentage	Weighted Percentage
Age: 18 or 19	28.8	43.4
Age: 20 or 21	31.1	24.5
Age: 22 to 24	17.6	11.3
Age: 25 to 29	17.1	12.6
Age: 30+	5.4	8.2
Race: White	70.4	69.2
Race: Black	4.3	5.3
Race: Hispanic	2.0	5.7
Race: Asian	16.1	12.5
Race: Other/Multi	7.3	7.3
Class: Freshman	5.5	17.2
Class: Sophomore	11.1	16.3
Class: Junior	20.6	17.3
Class: Senior	24.0	18.9
Class: Other UG	2.3	0.3
Class: Graduate/Prof	36.6	30.1
Mom's educ: < HS	2.7	3.1
Mom's educ: HS	11.5	11.8

[29] Data limitations prevented weights based on sex-race-class-age group cells.

Mom’s educ: Some coll	18.5	18.0
Mom’s educ: BA	36.1	34.4
Mom’s educ: > BA	31.1	32.8
Dad’s educ: < HS	3.2	3.0
Dad’s educ: HS	11.3	12.9
Dad’s educ: Some coll	14.7	13.1
Dad’s educ: BA	28.2	27.6
Dad’s educ: > BA	42.6	43.4
Financial Aid: Yes	63.8	62.1
Financial Aid: No	35.3	37.2
Credit card debt: No card	32.3	37.4
Credit card debt: Card, no balance	42.6	39.1
Credit card debt: < $500	11.0	10.3
Credit card debt: $500 - $999	6.0	4.8
Credit card debt: $1000 - $1999	3.7	4.1
Credit card debt: $2000+	4.4	4.4
N	860	

Survey Instrument

1. Are you currently a
   a. First-year undergraduate student
   b. Sophomore
   c. Junior
   d. Senior
   e. Other undergraduate student
   f. Graduate or professional student

2. In what year were you born?

3. Are you
   a. Male
   b. Female
   c. Transgender

4. What is your race/ethnicity? (check all that apply)
   a. White
   b. Black
   c. Hispanic or Latino
   d. Asian or Pacific Islander
   e. American Indian or Alaskan Native
   f. Other

5. What is your mother’s highest level of education?
   a. less than high school
   b. some high school
   c. high school diploma
   d. some college
   e. bachelor’s degree

f. master’s/professional degree
g. doctoral degree

6. What is your father’s highest level of education?
   a. less than high school
   b. some high school
   c. high school diploma
   d. some college
   e. bachelor’s degree
   f. master’s/professional degree
   g. doctoral degree

7. What is your major, intended major, or graduate program?
   a. Humanities
   b. Social science
   c. Engineering
   d. Science
   e. Arts
   f. Other, specify:

8. What is your current relationship status?
   a. Single (not currently dating)
   b. Dating or hooking up, but not seriously
   c. Steady, serious partner
   d. Cohabiting with partner and/or engaged
   e. Married
   f. Separated, divorced, or widowed

9. Do you currently have health insurance?
   a. Yes
   b. No
   c. I don't know

10. Does your health insurance cover prescription medications? [if Yes in 9.]
   a. Yes
   b. No
   c. I don’t know

11. Are you currently on your parents’ or guardians’ health insurance?
   a. Yes
   b. No
   c. I don't know

12. Have you ever been to University Health Services (UHS) for medical services or advice?
   a. Yes
   b. No

13. Have you ever filled a prescription at UHS?
   a. Yes
   b. No

14. How many times have you visited a health care professional in the last 12 months?

15. Of those visits, how many were at UHS (University Health Services)? [if yes in 12.]

16. Have you ever had vaginal sex?
  a. Yes
  b. No

17. Have you had vaginal sex within the last 30 days? [if yes in 16.]
  a. Yes
  b. No

18. While at the University of Michigan, have you or your partner(s) **ever** used any of the following kinds of contraception? (check all that apply)
  a. None; not sexually active
  b. None, sexually active
  c. Condoms
  d. Birth control pill
  e. NuvaRing (vaginal ring)
  f. Patch
  g. DepoProvera (a shot)
  h. IUD (intra-uterine device)
  i. Norplant/Implanon (implant)
  j. Diaphragm
  k. Fertility Awareness (rhythm, calendar, or safe period)
  l. Withdrawal (pulling out)
  m. Sterilization
  n. I don't know

19. **Within the last 30 days**, have you or your partner(s) used any of the following kinds of contraception? (check all that apply)
  a. None; not sexually active
  b. None, sexually active
  c. Condoms
  d. Birth control pill
  e. NuvaRing (vaginal ring)
  f. Patch
  g. DepoProvera (a shot)
  h. IUD (intra-uterine device)
  i. Norplant/Implanon (implant)
  j. Diaphragm
  k. Fertility Awareness (rhythm, calendar, or safe period)
  l. Withdrawal (pulling out)
  m. Sterilization
  n. I don't know

20. Where did you get the most recent prescription for your birth control? [if d, e, f, g, h, i, or j in 18. and b in 3.]
  a. Your primary care physician off-campus
  b. A non-campus clinic (Planned Parenthood, community clinics, etc.)
  c. UHS
  d. Somewhere else
     specify:

21. Where did you *fill* the most recent prescription for your birth control? [if d, e, f, g, h, i, or j in 18. and b in 3.]
  a. Stand-alone drug store (Walgreens, CVS, etc.)
  b. Pharmacy in a larger store (Wal-Mart, Costco, Meijer,etc.)
  c. A non-campus clinic (Planned Parenthood, community clinics, etc.)

d. UHS pharmacy
e. Mail-order or online company
f. UHS clinician [only if g, h, i, or j in 18. and b in 3]
g. Your primary care physician off-campus [only if g, h, i, or j in 18. and b in 3]

22. On a scale of 1 to 5, where 5 is most important and 1 is least important, how much do each of the following factors matter in determining where you fill your birth control prescription?
a. Price
b. Location/convenience
c. Wide availability of different brands
d. Other (specify)

23. Certain medical services, such as an HIV or other sexually-transmitted infection (STI) test, a pregnancy test, abortion, or prescription birth control, are often covered by health insurance. Have you ever declined one of these services or paid for it entirely out-of-pocket due to privacy concerns?
a. Yes
b. No
c. Not sure

24. Have you ever declined or paid entirely out-of-pocket for an HIV or other STI test, a pregnancy test, abortion, or prescription birth control because you were worried your parents would find out if you billed insurance?
a. Yes
b. No
c. Not sure

25. Have you ever received any kind of contraception (condoms, birth control prescriptions, etc.) from UHS?
a. Yes
b. No
c. Not sure

26. Were you aware that UHS offers the following free and confidential services to students?

	Yes	No
a. Pregnancy tests		
b. Contraception-related visits		
c. STI tests (gonorrhea, chlamydia, etc)		
d. HIV tests		

27. Now that you know UHS offers these services freely and confidentially to students, how likely are you to use UHS if you were in need of such services?

	Very likely	Somewhat likely	Not very likely	Very unlikely	Don't Know
a. Pregnancy tests					
b. Birth control prescriptions					
c. STI tests (gonorrhea, chlamyida, etc)					
d. HIV tests					

28. If you have a credit card, how much total credit card debt did you carry last month? That is, what was the total unpaid balance on all of your cards that you are responsible for paying?
a. Don't have own credit card
b. Have own credit card, but don't carry a balance
c. Less than $500
d. Between $500 and $1000
e. Between $1000 and $2000
f. More than $2000

29. Do you receive financial aid (grants or loans) at the University of Michigan?

a. Yes
b. No

30. Roughly how much of your tuition and fees does financial aid cover? [if a in 29]
a. All
b. Most (over 50%)
c. Some (less than 50%)
d. None

31. Roughly how much of your living expenses does financial aid cover? [if a in 29]
a. All
b. Most (over 50%)
c. Some (less than 50%)
d. None

Figure 1A: Mean Birth Control Rx Prices Paid, per month

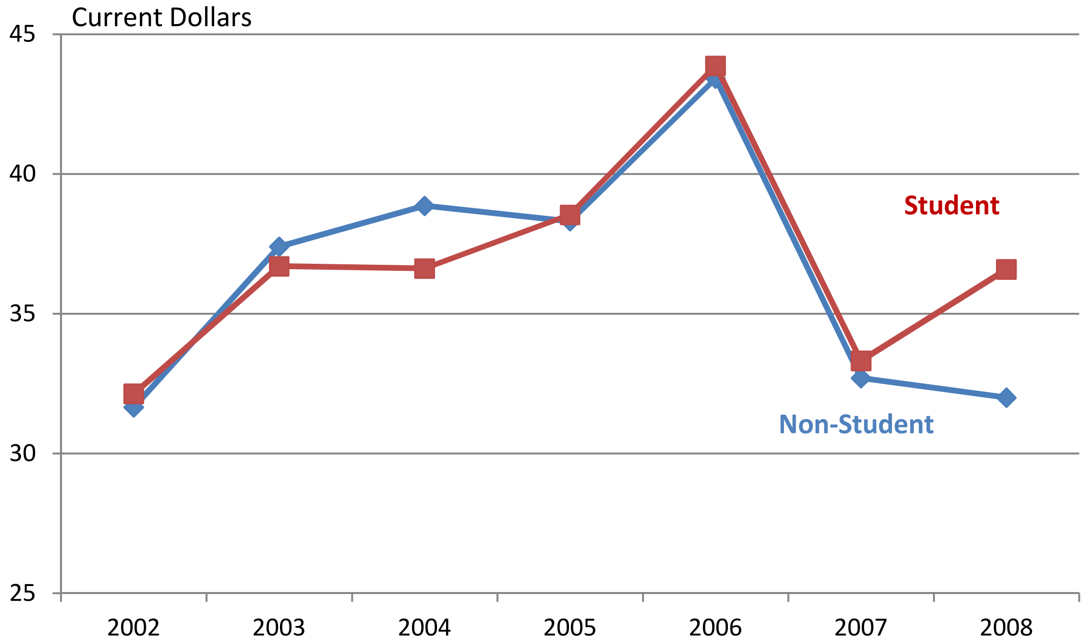
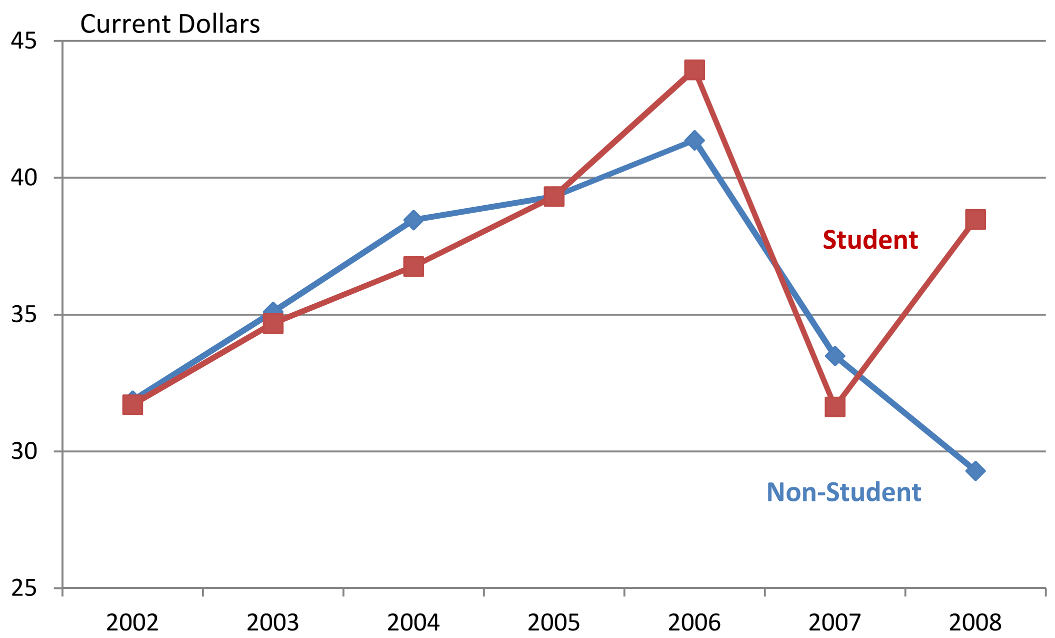


Figure 1B: Median Birth Control Rx Prices Paid, per month



NOTE: The outcome variable is the price paid by 18 to 29-year-old women for a 30-day supply of prescription birth control, excluding emergency contraception (i.e., the morning-after pill), separated by student status. There is a series break in 2007, when the method of data collection changed, but this should not have affected students and non-students differentially. Source: Authors' calculations from the Medical Expenditure Panel Survey (MEPS).

Figure 2A

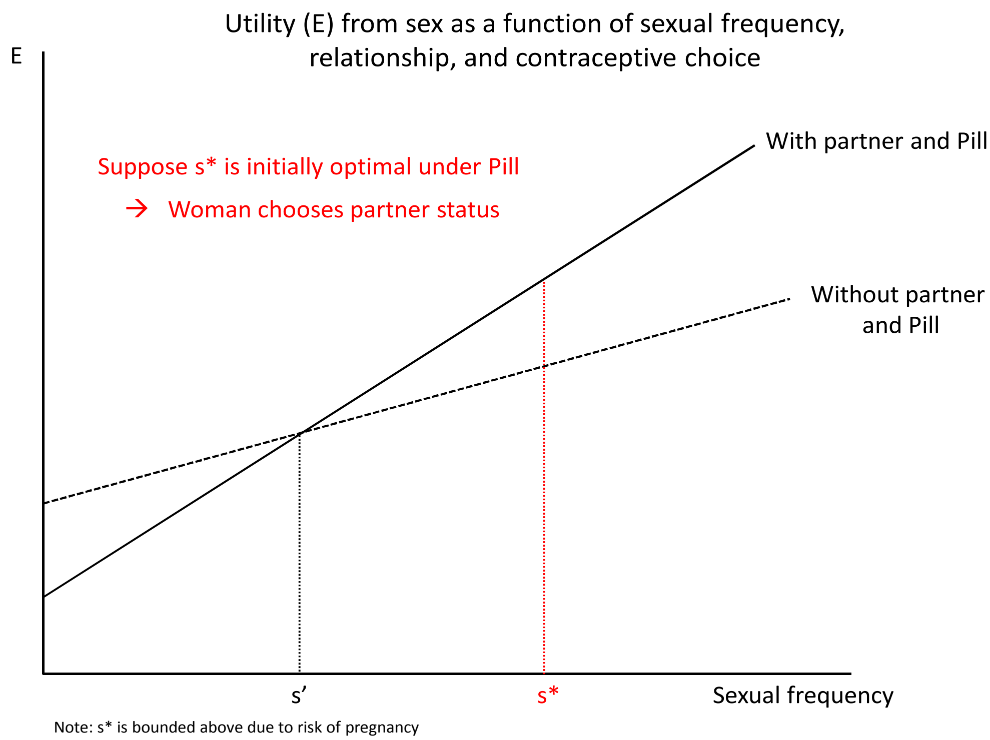


Figure 2B

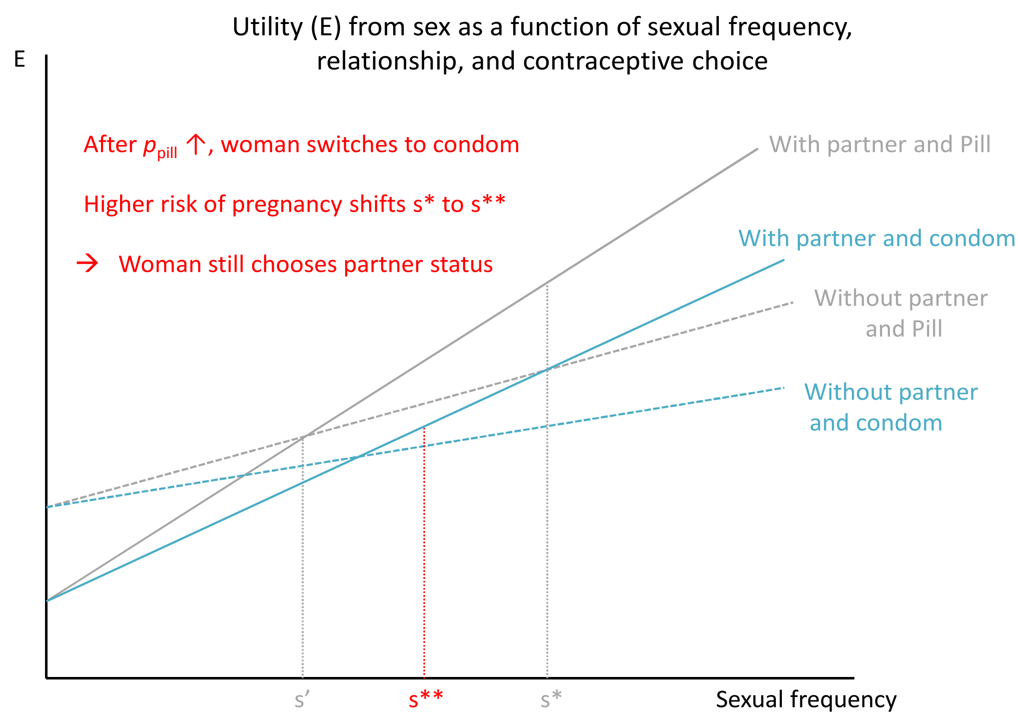


Figure 2C

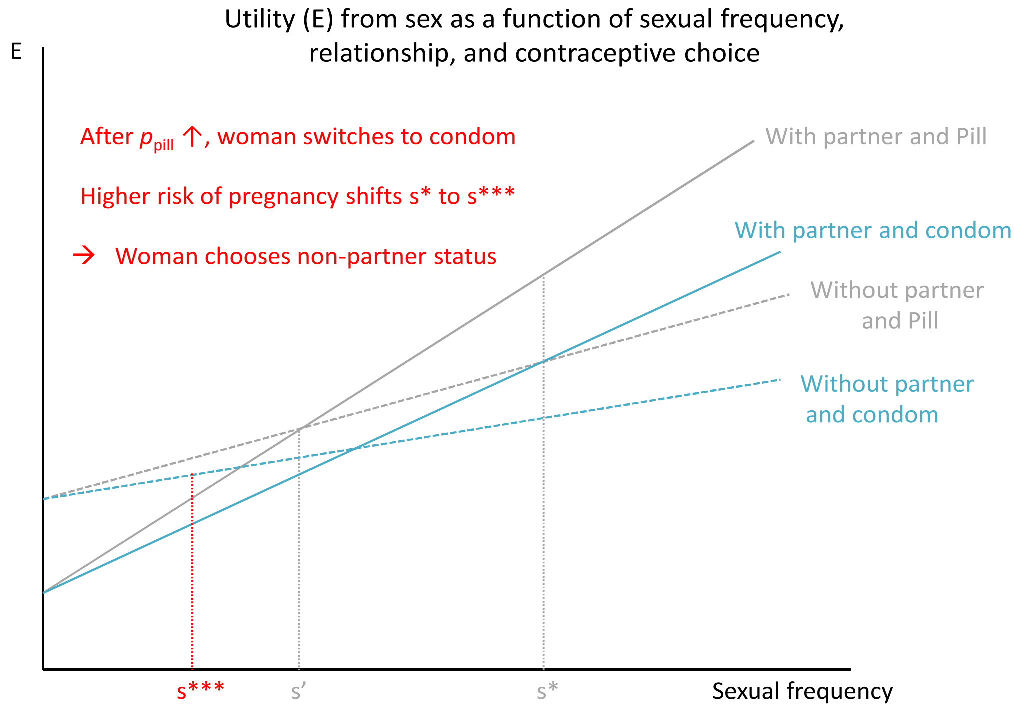

Utility (E) from sex as a function of sexual frequency, relationship, and contraceptive choice
E
After p_{pill} ↑, woman switches to condom
Higher risk of pregnancy shifts s* to s***
→ Woman chooses non-partner status
With partner and Pill
With partner and condom
Without partner and Pill
Without partner and condom
s***
s'
s*
Sexual frequency

Table 1: Comparison of NCHA sample to IPEDS and IPEDS full-time

	NCHA	*IPEDS*	*IPEDS: Full-time*
Age			
17-19	0.362	0.218	0.278
20-21	0.348	0.203	0.262
22-24	0.168	0.154	0.163
25-29	0.068	0.120	0.093
30+	0.045	0.202	0.110
Missing	0.010	0.104	0.093
Race/Ethnicity			
White	0.743	0.614	0.621
Black	0.056	0.122	0.116
Hispanic	0.054	0.093	0.091
Asian	0.096	0.054	0.059
Other/Missing	0.051	0.117	0.113
International Student	0.038	0.036	0.040
Level			
Undergraduate	0.882	0.773	0.846
Graduate/Professional	0.086	0.227	0.154
Full-time	0.952	0.717	1.000
Region			
Northeast	0.148	0.209	0.207
Midwest	0.230	0.244	0.240
South	0.237	0.330	0.327
West	0.319	0.196	0.205
Public	0.700	0.619	0.615
Carnegie Classification			
Baccalaureate	0.076	0.114	0.120
Masters	0.243	0.364	0.338
Doctoral	0.659	0.405	0.432
Enrollment			
< 2,500	0.046	0.133	0.140
2,500 – 4,999	0.038	0.125	0.122
5,000 – 9,999	0.144	0.173	0.163
10,000 – 19,999	0.380	0.235	0.229
20,000 +	0.393	0.335	0.345

Data shown represent female students attending 4-year colleges and universities over the 2000 through 2008 period. See text for information on the NCHA sample.

Table 2A: NCHA – Pill Use at Last Sex

	(1)	(2)	(3)	(4)
A: All College Women				
Mean DV = 0.418	-0.0167**	-0.0171***	-0.0200**	-0.0167***
n = 95,886	[0.0078]	[0.0061]	[0.0082]	[0.0060]
B: by School Size				
Large (5,000+)	-0.0177**	-0.0189***	-0.0211**	-0.0173***
	[0.0082]	[0.0064]	[0.0085]	[0.0063]
Small (< 5,000)	-0.0071	-0.0010	-0.0022	-0.0061
	[0.0117]	[0.0078]	[0.0196]	[0.0141]
C: by School Size, time FE				
Treat x Large	-0.0059	-0.0145*	-0.0196	-0.0153
	[0.0131]	[0.0084]	[0.0224]	[0.0167]
Demographic Controls		X		X
School-specific Time Trend			X	X

Standard errors, clustered at the school level, are in brackets. Dependent variable is Pill use at last sex; women who have not had sex are coded as a 0. Each panel-column is a separate regression. Sample is restricted to schools that participated in at least two NCHA surveys prior to Spring 2007 and at least one after Spring 2007. Spring 2007 is omitted. All specifications include school dummies. Demographic controls include dummies for season, age, race, class, health insurance status, credit card debt, full-time student status, residence type, and greek status. * indicates p<0.1, ** that p<0.05, and *** that p<0.01.

Table 2B: NSFG – Pill Use in Month

	(1)	(2)
A: All Women		
Mean DV = 0.184	-0.0368	-0.0130
N(obs) = 159,675	[0.0276]	[0.0204]
n(women) = 3,695		
B: Students Only		
Mean DV = 0.316	-0.0170	-0.0166
N(obs) = 14,637	[0.0272]	[0.0314]
n(women) = 576		
Demographic Controls or FE	D	FE

Standard errors, clustered at the PSU level, are in brackets. Dependent variable is Pill use in a given month. All regressions include population weights. Each cell is a separate regression that is based on a retrospective contraceptive calendar and restricts the sample to women who were interviewed during or after September 2007. Panel A presents difference-in-differences estimates between college women and non-college women. Panel B presents differences estimates for college women only. Demographic controls include dummies for age, education, race, insurance, and poverty status. * indicates p<0.1, ** that p<0.05, and *** that p<0.01.

Table 3A: NCHA – Pill Use by Insurance Status

	Has Health Insurance	No Health Insurance	Has Health Insurance	No Health Insurance
A: All College Women				
Mean DV | HI = 0.428	-0.0127**	-0.0363***	-0.0137**	-0.0349***
Mean DV | NHI = 0.354	[0.0059]	[0.0086]	[0.0060]	[0.0088]
n = 95,886				
B: by School Size				
Large (5,000+)	-0.0144**	-0.0368***	-0.0143**	-0.0349***
	[0.0062]	[0.0087]	[0.0063]	[0.0090]
Small (< 5,000)	0.0019	-0.0320	-0.0034	-0.0351
	[0.0095]	[0.0379]	[0.0153]	[0.0377]
C: by School Size, time FE				
Treat x Large	-0.0129	-0.0003	-0.0148	-0.0040
	[0.0096]	[0.0394]	[0.0180]	[0.0356]
School-specific Time Trend			X	X

Standard errors, clustered at the school level, are in brackets. Dependent variable is Pill use at last sex. All specifications include demographic controls. About 12 percent of the sample lacks health insurance, but this group is too small at smaller schools to be informative; in panel C, the restriction that the treatment effect is zero among students without health insurance at small schools is imposed to increase efficiency. See Table 2A for other notes.

Table 3B: NSFG – Pill Use in Month by Insurance Status

	Has Health Insurance	No Health Insurance	Has Health Insurance	No Health Insurance
A: All Women				
Mean DV | HI= 0.190	-0.0257	-0.0649	0.0091	-0.0865**
Mean DV | NHI= 0.154	[0.0312]	[0.0513]	[0.0249]	[0.0395]
N(obs) = 159,675				
n(women) = 3,695				
B: Students Only				
Mean DV | HI = 0.332	0.0058	-0.0896**	0.0263	-0.0863**
Mean DV | NHI= 0.266	[0.0311]	[0.0380]	[0.0202]	[0.0349]
N(obs) = 14,637				
n(women) = 576				
Demographic Controls or FE	D	D	FE	FE

Standard errors, clustered at the PSU level, are in brackets. Dependent variable is Pill use in a given month. All regressions include population weights. Each cell is a separate regression that is based on a retrospective contraceptive calendar and restricts the sample to women who were interviewed during or after September 2007. Regressions are run separately for each insurance condition. Panel A presents difference-in-differences estimates between college women and non-college women. Panel B presents differences estimates for college women only. Demographic controls include age, education, race, insurance, and poverty status. Insurance status is determined by whether the respondent had continuous health insurance coverage over the previous 12 months.

Table 4: NCHA – Pill Use by Credit Card Debt

	No debt	Positive debt	No debt	Positive debt
A: All College Women				
Mean DV | ND = 0.391	-0.0123*	-0.0301***	-0.0125**	-0.0283***
Mean DV | PD = 0.488	[0.0062]	[0.0087]	[0.0061]	[0.0090]
n = 95,886				
B: by School Size				
Large (5,000+)	-0.0129*	-0.0340***	-0.0120*	-0.0318***
	[0.0066]	[0.0088]	[0.0064]	[0.0092]
Small (< 5,000)	-0.0080	0.0445**	-0.0134	0.0388
	[0.0074]	[0.0205]	[0.0139]	[0.0267]
C: by School Size, time FE				
Treat x Large	-0.0016	-0.0751***	-0.0028	-0.0749**
	[0.0084]	[0.0205]	[0.0017]	[0.0283]
School-specific Time Trend			X	X

Standard errors, clustered at the school level, are in brackets. Dependent variable is Pill use at last sex. All specifications include demographic controls. About 69 percent of the sample carried no debt. See Table 2A for other notes.

Table 5: NCHA – Other Contraceptive Methods

	Non-Pill Rx	*Condom, no Rx*	*Other non-Rx*	*Nothing*	*Emergency contraception*
Mean DV	0.0622	0.1622	0.0816	0.0326	0.0919
A: All College Women	-0.0076**	0.0031	0.0031	0.0030	0.0039
	[0.0035]	[0.0046]	[0.0032]	[0.0021]	[0.0037]
B: by School Size, time FE	-0.0031	-0.0169***	-0.0074	0.0051	-0.0016
	[0.0059]	[0.0059]	[0.0078]	[0.0030]	[0.0068]

Standard errors, clustered at the school level, are in brackets. Each cell is a separate regression. Non-Pill Rx includes implants, injectables, patches, rings, and IUDs. Other non-Rx includes spermicide, fertility awareness, and withdrawal. The first four columns are mutually exclusive and measured at last sex; women who have not had sex are coded as a 0 for each outcome. Emergency contraception (the “morning after” pill) is for use over the last 12 months. All regressions include demographic controls. See Table 2A for other notes.

Table 6: NCHA – Sexual Behavior

	Ever had sex	*Had sex in last 30 days*	*In serious relationship*	*1+ male partners*	*2+ male partners*
Mean DV	0.689	0.505	0.457	0.675	0.217
A: All College Women	-0.0140**	-0.0049	-0.0253***	-0.0220***	-0.0177***
	[0.0065]	[0.0113]	[0.0057]	[0.0051]	[0.0044]
B: by School Size, time FE	-0.0321**	0.0144	0.0136	-0.0113	-0.0230**
	[0.0124]	[0.0164]	[0.0163]	[0.0137]	[0.0110]

Standard errors, clustered at the school level, are in brackets. Each cell is a separate regression. Each outcome is binary. Sex refers to vaginal sex with a male partner. "Serious relationship" includes students who are married, engaged, or in a committed relationship. The number of sexual partners is over the last 12 months. All regressions include demographic controls. See Table 2A for other notes.

Table 7: Sources for Rx Birth Control Among College Students

	All Students	Age 24 or younger	Age 25 or older	On Finan. Aid	Not on Finan. Aid	Insurance covers Rx	Insurance doesn't cover Rx
Use Rx BC	0.559	0.525	0.687	0.581	0.525	0.604	0.417
Use Rx BC | sexually active	0.743	0.744	0.741	0.743	0.739	0.781	0.611
Use Rx BC in last 30 days	0.385	0.381	0.400	0.390	0.385	0.423	0.266
Use Rx BC in last 30 days | sex in last 30 days	0.634	0.679	0.518	0.616	0.663	0.670	0.502
Obtained most recent Rx from:							
off-campus PC physician	0.488	0.536	0.349	0.426	0.591	0.521	0.337
off-campus clinic	0.056	0.055	0.058	0.062	0.044	0.046	0.103
university clinic	0.386	0.352	0.483	0.444	0.289	0.363	0.490
elsewhere	0.071	0.057	0.110	0.069	0.076	0.071	0.071
Filled most recent Rx at:							
stand-alone drug store	0.426	0.419	0.447	0.417	0.450	0.446	0.333
pharmacy in larger store	0.160	0.177	0.107	0.145	0.193	0.140	0.250
off-campus clinic	0.033	0.035	0.029	0.036	0.031	0.026	0.068
university clinic	0.202	0.191	0.235	0.221	0.167	0.196	0.229
mail/online pharmacy	0.069	0.086	0.017	0.055	0.076	0.074	0.047
university physician	0.024	0.002	0.088	0.033	0.007	0.026	0.012
off-campus PC physician	0.042	0.050	0.021	0.062	0.009	0.049	0.009
elsewhere	0.044	0.040	0.057	0.032	0.068	0.042	0.052
Factor is important or very important in deciding where to fill Rx:							
price/cost	0.723	0.702	0.783	0.763	0.637	0.676	0.935
convenience/location	0.827	0.813	0.867	0.832	0.820	0.843	0.755
availability/choices	0.258	0.247	0.292	0.269	0.222	0.268	0.210

The numbers shown represent the fraction of sample women from the university birth control survey answering each option. The sample size is 860 for rows 1 and 3 of the table, 622 for row 2 (which conditions on having had vaginal intercourse while at college), and 443 for row 4 (which conditions on having had vaginal intercourse in the 30 days prior to survey). The panels for obtaining and filling Rx, and the factors that are important in determining where to fill Rx, are conditional on having used Rx BC in college (row 1). The estimates reflect post-hoc weights to make the sample representative of the university on the basis of age, race, and class standing. Source: Authors' survey; see Survey Appendix.

Table 8: Importance of Determinants of Sources for Rx Birth Control, by Source, Among College Students

	Price is important/very important	Convenience/Location is important/very important	Availability/Choice is important/very important
Filled most recent Rx at:			
stand-alone drug store	0.632	0.814	0.275
pharmacy in larger store	0.849	0.810	0.238
off-campus clinic	1.000	0.770	0.269
university clinic	0.815	0.920	0.211
mail/online pharmacy	0.746	0.806	0.208
university physician	0.788	0.625	0.480
off-campus PC physician	0.540	0.769	0.339
elsewhere	0.580	0.884	0.281

The numbers shown represent the fraction of sample women from the university birth control survey who obtained their prescription birth control from the source indiciated that considered the specified factors as important or very important in determining where they filled their prescription. The estimates reflect post-hoc weights to make the sample representative of the university on the basis of age, race, and class standing. Source: Authors' survey; see Survey Appendix.