THE EFFECTS OF SCHOOL POLICIES ON STUDENT PREGNANCY RISK: EVIDENCE FROM THE ADD HEALTH

by

DANIELLE NICOLE ATKINS

(Under the Direction of W. David Bradford)

ABSTRACT

Teenage pregnancy is a significant public health concern in the United States due to the documented negative social and economic impacts associated with teenage childbearing for both parent and child. Schools offer an opportune place for policy interventions aimed at decreasing teenage pregnancy. This dissertation evaluated the effect of three policies related to student reproductive health, providing including school-linked daycare, offering family planning services, and requiring pregnant students to attend separate schools, on 1) student sexual behaviors that determine pregnancy risk and 2) potential attitudinal mechanisms between the policies and sexual behaviors. I studied these questions using the National Longitudinal Study of Adolescent Health (Add Health), which is a nationally representative survey of youth. In order to guide my thinking about these questions, I developed a dynamic model of decision-making about protected and unprotected sexual activity based in neoclassical economic theory. My findings indicated that these policies do matter with regard to student decisions about sexual behaviors that put them at risk for pregnancy and attitudes that have been linked to sexual risk-taking behaviors. Policy implications are discussed.

INDEX WORDS: Teenage pregnancy, School policy, Sexual risk-taking, Youth

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DANIELLE NICOLE ATKINS

B.A., University of Tennessee, 2006

M.P.A., University of Georgia, 2009

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DANIELLE NICOLE ATKINS

Major Professor:	W. David Bradford
Committee:	Vicky Wilkins
	Angela Fertig
	Jeffrey Wenger

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
May 2013

DEDICATION

This dissertation is dedicated to Dan. Thank you for being there every step of the way.

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CHAPTER 1

INTRODUCTION

BACKGROUND

Teenage pregnancy represents a significant public health concern in the United States due to the documented negative health, social, and economic impacts associated with adolescent childbearing. Schools provide an opportune place for policy interventions aimed at preventing teenage pregnancy; however, careful evaluations are needed in order to understand the effects of school policies on student sexual behaviors in order for these policies to be effective in preventing teenage pregnancy. This dissertation aims to expand our knowledge by modeling the effects of school policies on student behaviors that determine pregnancy risk and student attitudes about sex and teenage pregnancy.

There are many negative consequences from teenage childbearing. Pregnant teenagers are at greater risk for premature births, low birth weight and infant mortality (Ventura, Mathews et al. 2001). Teenage mothers have a greater likelihood of not graduating high school and being single mothers than women who do not experience pregnancy until 20-21 years of age (Hoffman 2008). Children who are born to teenage mothers are more likely to have academic, behavioral, and chronic health problems and are at higher risk for incarceration, high school dropout, teenage pregnancy and unemployment (Hoffman 2008). In addition to creating negative outcomes for teenage parents and their children, a substantial amount of financial cost stemming from teenage

pregnancy is borne by the public. In 2004, federal, state and local governments spent around $9.1 billion dollars in relation to teenage childbearing (Hoffman and Pregnancy 2006).

Given these social and economic problems, many policies and programs have been developed and implemented to prevent teenage pregnancy or to ameliorate the negative consequences associated with young parenthood. The school provides a key setting for interventions of this nature, since adolescents spend a significant amount of time in school and since their social networks generally consist of peer groups formed in the school setting (Kirby 2002). However, the appropriateness of the school setting for intervening upon student sexual and reproductive behaviors is heavily debated. Proponents of school-involvement in student reproductive health contend that teenagers are engaging in sexual activity and school policies should aim to mitigate the consequences of this behavior. Conversely, opponents to school-based policies and programs targeting student sexual and reproductive health often argue that sex education is not the school's responsibility and that policies such as sex education, family planning services, or condom availability programs may actually encourage sexual activity among students. I will inform this debate by examining the effects of school policy and student characteristics on student sexual behaviors and attitudes.

Despite a great deal of research, teenage pregnancy remains a significant problem in the United States. As such, the aim of this dissertation is to specifically explore the effects of school policies and characteristics on students' decisions regarding sexual activity, contraceptive use, and sex/pregnancy attitudes. Although a large body of research on the effects of sex education and various program evaluations of specific interventions on student sexual and reproductive health outcomes exists, the effects of a multitude of other school policies that may affect student reproductive health have yet to be explored. In addition, few studies of teenage pregnancy and

adolescent reproductive behavior have adopted an economic approach. Thus far, economic analyses of adolescent sexual behavior have focused on the effects of sex education and state or national family planning policies on teenage pregnancy. Most economic studies of teenage sexual or reproductive behavior focus on the adolescent's choice to become pregnant and do not explicitly model teenage sexual frequency or contraceptive use behaviors. The goal of this dissertation is to extend the literature on both the determinants of teenage pregnancy and the effects of various school-level policy levers that may affect teenage pregnancy by presenting an economic model of the probability that a student experiences pregnancy as a teenager.

The specific aims of this dissertation are:

1. Using economic neoclassical decision theory, develop a model of teenage decision-making regarding sexual behaviors that put teenagers at risk for pregnancy.
2. Based on the theoretical model, identify policy levers relevant to the decision process and identify potential pathways for these policies to affect adolescent decision-making.
3. Evaluate the effect of school policies and/or characteristics related to student sexual and reproductive health on adolescent decision-making regarding sexual behaviors that determine pregnancy risk and sex/pregnancy attitudes that might operate as mechanisms between the policies and behaviors.

REVIEW OF THE LITERATURE AND SIGNIFICANCE

My dissertation addresses gaps in the literature on the effects of school-based policies including school-linked daycares, family planning services, and separate schooling for pregnant students, on student sexual behaviors and sex/pregnancy attitudes. Perhaps the most extensively studied area of school policies related to reproductive health has been on the effects of sex

education on student reproductive behaviors and outcomes. However, there is also evidence regarding the effects of other types of school-based reproductive health related policies such as offering family planning counseling or providing contraceptives to students.

The effects of a school providing daycare on the reproductive behaviors of students without children have yet to be analyzed. To my knowledge, this dissertation is the first to explore the effects of providing school-linked daycares on student sexual behaviors and attitudes. The effects of offering family planning services at the school on sexual behaviors have been studied; however, these analyses tend to be program evaluations on a small number of students or schools. My dissertation extends research in this area by examining the effects of this school policy using a nationally representative dataset. Like daycare, the effect of separate schooling for pregnant students on student sexual behaviors and attitudes has yet to be analyzed. This policy is particularly interesting because, although pregnant or parenting students can opt into separate schooling (including home schooling), the federal law known as Title X (which was implemented before the study I will take data from began) makes it illegal for schools to require pregnant students to attend separate schools.

In addition to examining the effects of these policies on sexual behaviors, including frequency and contraceptive use, I also studied how these school policies affected student sex and pregnancy attitudes, which might act as a mechanism between the policies and ultimate sexual behaviors. Although the link between student sex and pregnancy attitudes, sexual behaviors and outcomes (such as sex frequency, contraceptive use, and pregnancy risk) have been well-studied, how school policies might intervene on student attitudes and beliefs has not been evaluated. My dissertation addresses this gap in the literature by examining how school policies related to reproductive health influence student attitudes concerning human capital

formation, the psychological cost of sex as a teenager, and the perceived disutility of teenage pregnancy.

RESEARCH PLAN

The research design for this analysis includes developing a dynamic (two period) theoretical model of student decision-making regarding sexual frequency and contraceptive intensity. This theoretical model is based on the economic theory of rational decision-making. The purpose of developing this model is to inform the empirical analyses of the effect of school policy and student characteristics on student decisions about behaviors that put them at risk for pregnancy. The theoretical model helps identify policy levers relevant to the decision process and potential pathways for these policies to affect adolescent decision-making. In addition, exploring the predictions of the model in the comparative statics provides guidance regarding what the effects of the different parameters may be.

Using the predictions from the theoretical model as a guide, the empirical portion of the dissertation will involve two separate analyses. The first empirical chapter assesses the effect of school policies on student sexual behaviors that determine pregnancy risk. More specifically, the student outcomes include: 1) any sexual activity during the school year; 2) school year sexual frequency; 3) any birth control use, conditional on sexual activity; and 4) sexual strategies which are represented by eight possible choices that combine both sexual frequency and contraceptive use. The second empirical chapter models the effect of the three school policies on mechanisms that could link the policies to sexual behaviors. These include: 1) human capital expectations; 2) psychological cost of pregnancy as a teenager; and 3) expected disutility of teenage pregnancy.

I use data from the National Longitudinal Study of Adolescent Health (Add Health) to analyze these questions. The Add Health is a nationally representative longitudinal survey of adolescents in grades seven through twelve beginning in the 1994-1995 school year. The Add Health data are well-suited for these analyses because they contain information on school policies from the Wave 1 administrator surveys (about school characteristics) and student in-home surveys that detail information on individual respondents including their reproductive behaviors, expectations, and sex/pregnancy attitudes.

In Chapter 2, I provide a literature review of what we currently know about the effects of these school policies on student sexual behaviors that determine pregnancy risk as well as the student attitudinal outcomes I examine. Additionally, I review literature that supports these adolescent attitudinal variables as potential mechanisms linking school policies to sexual behaviors. My theoretical model is presented in Chapter 3. Chapter 4 focuses on the models estimating the impact of school policies on student sexual behaviors that determine pregnancy risk, and Chapter 5 explores the relationship between these school policies and student attitudinal variables that have been shown to affect pregnancy risk. Finally, Chapter 6 concludes the dissertation with a discussion of policy implications.

CHAPTER 2

LITERATURE REVIEW

OVERVIEW OF SCHOOL POLICY AND STUDENT REPRODUCTIVE BEHAVIORS

Almost half of all high school students report being sexually active, which puts them at risk for pregnancy and sexually transmitted infections (STIs). Teenage pregnancy is a significant public health concern in the United States, and various approaches exist that aim to decrease teenage pregnancy. In order to affect teenage pregnancy rates in the United States, it is necessary to understand the determinants of behaviors that increase adolescents' risk for pregnancy, including sexual frequency and contraceptive intensity. Much work has been published in the literature identifying protective and risk factors for teenage pregnancy. The effects of policy interventions on these behaviors have also been extensively studied. For example, the effect of sex education on sexual behaviors of adolescents has been studied using nationally representative datasets as well as specific sex education programs. Experimental and quasi-experimental evaluations of specific interventions such as condom availability programs or school family planning clinics have also been completed. I will discuss the details of these literatures below.

My dissertation adds to the literature on both the determinants of teenage pregnancy and the effects of various policy levers that may affect teenage pregnancy by presenting an economic model of adolescent behaviors that determine the probability of teenage pregnancy.

Although teenage pregnancy is a widely studied topic, few studies have adopted an economic approach. Thus far, economic analyses of adolescent sexual behavior have focused on the effect of sex education and state or national family planning policies on teenage pregnancy. Most economic studies of teenage sexual or reproductive behavior (discussed below) focus on the adolescent's choice to become pregnant and do not explicitly model teenage sexual frequency or contraceptive behaviors. My dissertation extends the economic literature in this area in two ways: 1) by examining the effect that school policy have on the student sexual behaviors and pregnancy risk, and 2) by modeling the effect of school policies on student sex and pregnancy attitudes that might operate as mechanisms between the policy and sexual behaviors that determine pregnancy risk.

Schools offer a potential setting to affect the sexual risk-taking behavior of adolescents. Several theories exist regarding how schools may affect student sexual behaviors. First, going to school may decrease the opportunities for sex by imposing time constraints on students. Schools may also be characterized by an atmosphere that deters students from engaging risky behaviors. Peers have been shown to affect sexual risk-taking behaviors by adolescents, and the formation of peer groups takes place, in large part, in the school setting. Schools may affect an adolescent's sexual behavior decisions by influencing future goal setting, such as cultivating a student's desire to go to college or professional ambitions. Finally, schools may affect students in other ways that promote healthy decision-making such as building self-esteem, self-efficacy, and negotiation skills (Kirby 2002).

School policy setting surrounding sexual and reproductive health is often a contentious and debated topic. Take the abstinence-only versus comprehensive sex education debates, for example. Although we often hear about sex education policies and funding decisions at the

federal and state levels, schools also participate in policy formation related to student reproductive health. For example, it is becoming more common for schools to offer daycares for parenting students. Schools also have policies that provide family planning services, such as offering free condoms, to students. These policies are often scrutinized because individuals and groups opposed to these types of policies argue that they decrease the costs associated with sexual activity and teenage pregnancy. More punitive policies also exist. For example, some schools require pregnant students to attend separate schools. Given that students spend a significant portion of their time in the school setting and that teenage pregnancy is a pressing public health concern in the United States, it is important that we understand how school-level policies affect student sexual behaviors that determine pregnancy risk. This is the focus of my dissertation.

For this dissertation, I studied how three school policies related to reproductive health including: 1) offering school-linked daycare; 2) providing family planning services; and 3) requiring pregnant students to attend a separate school, affected student sexual behaviors, pregnancy risk, and sex and pregnancy attitudes. In reviewing the literature in this area, I will focus on what we know about how each of these policies affects each of the outcomes I am interested in studying.

POLICY INTERVENTIONS

School-linked Daycare

Although providing school-linked daycare is becoming more common, we know very little about the effects of these policies on students. What has been studied has focused on how daycares affected outcomes for parenting students. To my knowledge, no study has examined

the potential spillover effects of providing school-linked daycare on non-parenting students. The potential spillover effect associated with daycare could increase or decrease pregnancy risk. For example, attending a school with a daycare might lead to riskier sexual practices if the student believes having the option of a daycare decreases the costs associated with becoming pregnant as a teenager. However, the effect might encourage less risky behavior if school-linked daycares keep parenting students in school, thereby exposing non-parenting students to stories about the difficulties of teenage childbearing and parenting from students who may have otherwise dropped out of school.

Childcare is often a critical issue for teenage mothers because lack of childcare makes it difficult for them to remain in school. The most common source of childcare for teenage mothers is through family networks; however this type of childcare is often unstable and difficult for the mother to manage (Sadler, Swartz et al. 2007). The goal of school-based childcare is to address this issue for teenage mothers and help them to stay in school.

Several studies have explored the impact of school-based daycare programs on teenage mothers. In a study of a school-based child care center, the findings indicated that a childcare center provided by the school for at-risk teenage mothers may have promoted school engagement for the mothers, improved their parenting skills, and decreased repeat pregnancies (Sadler, Swartz et al. 2007). Another evaluation of the impact of a school-based childcare center found that students who self-selected into the program showed academic improvement, did not experience repeat pregnancy while participating in the child care program, and their children obtained recommended medical care such as check-ups and immunizations (Williams and Sadler 2001). Comparing a group of teenage mothers who participated in a school-based childcare center with a group who applied but did not participate, Crean, Hightower, and Allan (2001)

found that the participants were more likely to graduate (70%) than non-participants (28%) (Crean, Hightower et al. 2001).

Although these studies examined the effects of school-based childcare on outcomes for teenage mothers and their children, an analysis of the effects of providing school-based childcare on the sexual behaviors of students who have not experienced pregnancy has yet to be conducted. This dissertation seeks to extend research on the effects of school-linked childcare by examining the impact of these programs on student sexual behaviors, pregnancy risk, and sex/pregnancy attitudes.

Family Planning Services

School-based health centers typically offer a number of services, one of which may be family planning services. Family planning services include prescribing or dispensing contraceptives. These services may be provided through school-based health clinics, school-linked health clinics, or through condom availability programs (which do not require a health clinic). Like school-linked daycares, researchers have evaluated the impacts of school-provided family planning services on contraceptive use, sexually transmitted disease transmission, and pregnancy. Evidence is mixed regarding the effects of family planning service availability on contraceptive use; some studies find that school family planning services have a positive effect on contraceptive use for sexually active students, while some studies find no effect (Kirby 2002; Ethier, Dittus et al. 2011; Smith, Novello et al. 2011). There is evidence that students simply substitute school-provided contraception for their previous source of contraceptives. However, with regard to sexual frequency studies in this area have generally found that initiation rates are

not higher in schools that offer family planning services or condom availability programs (Kirby 2002; Ethier, Dittus et al. 2011; Smith, Novello et al. 2011).

Further, little is known about potential spillover effects of offering family planning services. It is possible that by lowering the cost of protected sex, family planning services induces students to initiate sexual activity or might increase frequency for students who are already sexually active.

Separate Schooling for Pregnant Students

Title IX of the Education Amendments of 1972 (Title IX) prohibits discriminatory treatment of students based on sex, which includes pregnant teens. Title IX mandates that if a pregnant student was to participate in a separate program, it must be voluntary (McNeeley 2007). Although *requiring* separate schooling for pregnant students would seem to violate the voluntary nature of choosing to be in any kind of program for pregnant students set forth by Title IX, this practice continues to persist; approximately 34 percent of schools in the data used for this study, which were collected more than 20 years after Title IX, indicated that they required pregnant students to attend separate schools.

Like school-linked daycare, research on the effects of separate schooling requirements has focused on the effects of these policies and programs on pregnant or parenting teens. One study comparing outcomes for pregnant students at a comprehensive school for pregnant/parenting teens to comparable pregnant teens in public school found that students in the comprehensive school had greater educational expectations, improved reproductive health, more birth control use, and were more likely to breastfeed (or intend to breastfeed) than non-program participants (Amin, Browne et al. 2006). Another study evaluating the same alternative school

(using the same data) found that program participants reported higher contraceptive use or intent to use and less desire for subsequent children (Amin and Sato 2004). Neither of these analyses empirically addressed selection into the program.

Another study, with an arguably more robust study design, evaluated the effect of a separate school for pregnant students (the McCabe Center in New Haven, CT) on birth outcomes. The researchers used differences in gestation length at entry to the program, which naturally occurred due to summer vacation, as their variation in treatment. They found that students who entered the program earlier during pregnancy due to timing of conception were less likely to deliver pre-term, low birth weight babies than pregnant students who exogenously entered the program later in pregnancy due to the timing of conception which resulted in delayed treatment because of summer vacation (Seitz and Apfel 1994). In previous evaluations of the same program, the authors found that students in the program had improved educational outcomes and less likelihood for repeat childbearing (Seitz, Apfel et al. 1991; Seitz and Apfel 1993).

Although, there are more studies evaluating the impact of these types of programs on outcomes for pregnant and parenting students, I did not find any studies that evaluated the potential impact of separate schooling requirements for pregnant students on the pregnancy risk or attitudes related to pregnancy risk of non-pregnant students. This policy could either increase or decrease pregnancy risk. For example, students may view this policy as punitive in nature. They may be less likely to engage in behaviors that lead to pregnancy if they believe they would have to leave their school and social network. However, removing pregnant students from school may have the opposite effect by disconnecting non-pregnant students from information that would be provided by their pregnant peers that might highlight the difficulties in teenage pregnancy. For example, using a friend's miscarriage as exogenous variation in treatment,

Yakusheva and Fletcher (2013) found that compared to friends of students who became pregnant and carried the baby to term, those whose friends miscarried had a 7-11 percentage point lower probability of their own teen childbearing (Yakusheva and Fletcher 2013)

Summary

With regard to daycare and separate schooling policies, it seems that the research in this area has focused on outcomes for pregnant or parenting teens and no research has been completed on the potential spillover effects associated with these policies. The impact of family planning services in schools on student sexual risk-taking behaviors has been studied much more extensively; however, the studies in this area are mainly focused on small samples of one or a few schools. My dissertation extends this research by examining the impact of daycare policy and separate schooling policy on non-pregnant students and extends the research on family planning services by examining the effects of the policy on sexual risk-taking behaviors of students using a nationally representative sample of youth.

ATTITUDES AND RISK-TAKING BEHAVIORS

Now that the literature on the effects of the school policies being studied in this dissertation has been covered, it is important to review the extant literature related to the expectations and attitudes that I will be studying in the second empirical portion of the dissertation (Chapter 5). Importantly, I did not find any research that focused on the relationship between school policies and the attitudinal outcomes in Chapter 5 (expectations for the future, psychological cost of sex as a teenager, and the expected disutility of teenage pregnancy);

however, there were several studies that used these attitudinal variables as predictors of risk-taking behaviors.

Future Expectations and Risky Behaviors

Expectations for the future have been linked to risky health behaviors by youth (Harris, Duncan et al. 2002; Clark, Kim et al. 2006; Borowsky, Ireland et al. 2009; Cowan 2011; McDade, Chyu et al. 2011). Higher expectations for educational attainment and income may decrease current risk-taking behaviors by adolescents because the potential cost of foregone opportunities increases as students expect a better future. Having high expectations for education and labor market outcomes likely indicates that an adolescent is forward-looking and considers the consequences of her actions today on her future opportunities and outcomes. If this is the case, then a student with high expectations is likely less prone to engage in risk-taking behaviors, including those behaviors that put her at risk for pregnancy, than a student who does not have high expectations for her future educational and labor market outcomes.

McDade et al. (2011) examined the link between adolescents' expectations for the future and risky health behaviors using data from the National Longitudinal Study of Adolescent Health (Add Health). Their findings indicated that students who had higher expectations for attending college exercised more and smoked less. In addition, adolescents who had greater expectations of living to age 35 were less likely to smoke. Although parent's education was a significant predictor of expectations and risky health behaviors, expectations for the future had an independent effect on risky health behaviors in youth (McDade, Chyu et al. 2011).

Clark et al. (2006) used data from the Dunedin Multidisciplinary Health and Development Study (DMHDS) to evaluate the role of future expectations in risky health

behavior and educational investment of adolescents (Clark, Kim et al. 2006). Their findings indicated that youths with lower expectations for success in the future were more likely to smoke, not exercise, and fail to graduate high school. Although low initial social and health capital and intelligence also affected these behaviors, the independent effect of future expectations on smoking and exercise remains even after these variables are controlled for (Clark, Kim et al. 2006) .

Studies have also found evidence that expectations for the future are linked to sexual risk-taking behaviors by adolescents. Using Add Health data, Borowsky, Ireland, & Resnick (2009) found that higher perceived risk of early death predicted risky sexual behaviors by adolescents (Borowsky, Ireland et al. 2009). Harris, Duncan, and Boisjoly (2002) found that higher expectations for living to age 35 and for attending college was associated with decreased likelihood of onset of sexual activity for male and female students (Harris, Duncan et al. 2002).

Expectations regarding income have also been shown to decrease sexual risk-taking behaviors and subsequent teenage nonmarital births. Wolfe, Wilson, and Haveman (2001) found that higher expected costs associated with nonmarital teenage childbearing led to less sexual risk-taking behaviors and lowered the probability of subsequent teenage nonmarital childbearing (Wolfe, Wilson et al. 2001).

These studies provide evidence that expectations for the future, such as human capital expectations, can influence sexual risk-taking behaviors of adolescents that determine pregnancy risk. Given this established relationship, these expectations could operate as mechanisms between policies and behaviors. My dissertation extends literature in this area by testing the effect of school policies on student expectations for the future.

Psychological Cost of Sex as a Teen

Using data from the Add Health Cuffee et al. (2007) studied the relationship between sex attitudes and sexual debut. They factor analyzed items and created an outcome for variables related to shame or guild associated with sexual activity and found that higher perceived shame or guilt associated with sex decreased the likelihood of sexual debut for white male and female students (Cuffee, Hallfors et al. 2007). This study is the most related to what I study in Chapter 5; however, other analyses have studied the link between adolescent sexual activity and depression.

Sabia and Rees (2008) used instrumental variables and fixed effects estimation to study the relationship between adolescent sexual activity and depression. They found, based on their IV estimates, that sexually active female respondents were at greater risk for depression than their non-sexually active counterparts. Interestingly, when they limited the sexually active sample to those who used contraception at last intercourse, they found that risk for depression was lower, but did not disappear, when comparing the sexually active (using contraceptives) group and the non-sexually active group (Sabia and Rees 2008).

These studies demonstrate that perceived and actual psychological costs of sexual activity as a teenager exist and that perceived guilt and shame can be protective for some groups of students. Given that sexual activity as a teenager has been shown to increase risk for depression for females and that feelings of guilt and shame have been associated with decreased probability of sexual activity for some students, it is important to understand how school policies might intervene on attitudes about guilt associated with sexual activity as a teenager, which I explore in Chapter 5.

Expected Disutility of Teenage Pregnancy

To my knowledge, no study has assessed the effect of school policies on student attitudes about pregnancy; however, researchers have examined how pregnancy attitudes affect pregnancy risk. Using data from the Add Health, Brückner, Martin, and Bearman (2004) found that, among sexually active female students, ambivalent attitudes toward pregnancy (defined as not having formed an opinion regarding teenage pregnancy) were associated with decreased likelihood of contraceptive use (Brückner, Martin et al. 2004). A second study using Add Health data found that more positive pregnancy attitudes were associated with increased likelihood of subsequent teenage pregnancy (Jaccard, Dodge et al. 2003). A third study, also using Add Health data, found that more negative pregnancy attitudes were associated with increased likelihood of consistent contraceptive use for female students (Ryan, Franzetta et al. 2007).

These studies suggest that pregnancy attitudes play an important role in predicting subsequent pregnancies and contraceptive use. Given that we know attitudes about teenage pregnancy affect student behaviors, it is important to consider how these attitudes might be shaped by school policies, which is part of the focus of this dissertation.

CHAPTER 3

THEORETICAL MODEL

INTRODUCTION

I develop an economic model of teenage pregnancy that emphasizes the effect of the school environment and school policies on teenage pregnancy in order to understand how various school policies relatied to student reproductive health change the probability that a student experiences pregnancy. I will model this effect by considering the impact that these policies have on pregnancy risk, which is a function of sexual frequency and contraceptive intensity. The model will also account for individual and environmental factors that have previously been identified in the literature as affecting the probability that an adolescent experiences pregnancy; however, the main focus of the model is to understand how the costs and benefits created by school policies affect the probability that an adolescent experiences pregnancy. It is likely that policies affecting pregnancy risk also change the probability that a student contracts a sexually transmitted infection (STI). As such, the model accounts for the probability and cost of contracting a STI, but this is a secondary objective to understanding the effects of these policies on teenage pregnancy.

In order to understand the effects of school policies on teenage pregnancy, I consider a model in which adolescents are rational decision makers. They make decisions about behaviors that put them at risk for pregnancy within a framework of rational choice that takes into account the marginal opportunity costs and marginal benefits associated with these behaviors.

Economists have utilized the rational-choice framework to model teenage fertility but have generally avoided modeling sexual frequency and contraceptive intensity in this way. Researchers in other disciplines argue that adolescent sexual behavior is a function of the stage of development, and that sexual behavior becomes less impulsive with age. Evidence from psychology suggests that there is a biological/developmental component to risky decision-making by adolescents. In fact, findings indicate that the pre-frontal cortex of the brain, which regulates self-control, is not fully developed until late adolescence (Steinberg 2005). In addition, sexual activity by teenagers often exhibits time inconsistencies (Gruber 2001). For these reasons, teenage sexual behaviors are often considered anything but the product of a rational decision-making process by psychologists.

Despite this widespread skepticism, there is evidence that adolescents can engage in rational decision making regarding sexual behavior and that they respond to economic incentives. First of all, teenage pregnancy is a predominantly American problem. The teenage pregnancy rate is higher in the United States than in Great Britain, Canada, France and Sweden (Darroch, Singh et al. 2001). This speaks against the idea that teenagers cannot control their fertility and suggests that societal factors play an important role in teenage pregnancy rates at the national level (Levine 2001).

In addition, economic analyses of teenage fertility indicate that adolescents do respond to incentives. Levine (2001) found that teenagers can be responsive to prices associated with sexual activity and/or contraceptive use (Levine 2001). More specifically, if the cost of sexual activity increased, either through improved labor market expectations or a higher probability of contracting AIDs, then teenagers were less likely to be sexually active and/or more likely to use contraception.

In modeling adolescents as rational decision makers, I make several assumptions about their behavior. First, I assume adolescents consider the costs and benefits associated with their choices, including the future stream of costs and benefits from current decisions. Applied to modeling adolescent pregnancy risk, this means that an adolescent chooses how much sexual activity and contraception to consume today based on the costs and benefits of these decisions today and the discounted costs and benefits of these decisions in the future. A rational adolescent will engage in sexual activity if the benefits of sexual activity outweigh the costs. The same holds for contraceptive use. When taken together, sexual frequency and contraceptive intensity define an adolescent's risk for pregnancy, so it follows that an adolescent will be at risk for pregnancy when the benefits associated with taking on these risks outweigh the costs. In this choice framework, school policies can alter the costs or benefits of sexual frequency, contraceptive intensity and, ultimately, teenage pregnancy. For example, if the cost of pregnancy risk is decreased because the school provides a daycare for teenage mothers, this should affect the choices that determine pregnancy risk.

To explore the possible effects of school policies on student sexual and reproductive health, I consider a model in which adolescents maximize the present value of their expected utility with respect to sexual frequency and contraceptive intensity. The adolescent maximizes expected utility because of the uncertainty introduced into the decision-making process due to the fact that sexual activity and contraceptive use may result in pregnancy or it may not. I limit this model to female students because the outcome of interest is pregnancy risk.

I develop a dynamic model of reproductive decision-making in which the adolescent maximizes her expected utility by considering the costs and benefits associated with pregnancy risk and then chooses the amount of sexual activity and contraception to consume that maximizes

these benefits over two time periods. The dynamic nature of the model also accounts for the temporal aspects of her decision-making regarding pregnancy risk because she includes the future stream of costs and benefits associated with pregnancy risk in her decision calculus. These future costs and benefits are discounted since they are occurring at a later point in time.

In this dynamic model, I consider the adolescent at two points in time. In the current period, she is deciding how much sexual activity and contraception to consume. Her utility in the first period, when she is an adolescent, comes from consumption of other goods, unprotected sexual activity, and protected sexual activity. As an adolescent, she also considers the future impact of her current decisions on her expected utility in the terminal period when she is an adult. In the second period, she maximizes her utility as a function of other goods and sexual activity. I do not delineate between unprotected and protected sexual activity in the second period since the implications of school policies on these decisions are not applicable. There are two possible states of the world in period two: either she was pregnant as a teenager, or she was not pregnant as a teenager; these two states have different labor market implications. The dynamic model portrays a decision-making process in which the adolescent considers her discounted expected utility in period two (a probabilistic combination of both the state of having been pregnant as a teenager and the state of not having been pregnant as a teenager) and the utility she will gain in the current period from sexual activity. The dynamic programming problem is solved using backward induction.

Consider an adolescent who is currently choosing her levels of unprotected and protected sexual encounters. Pregnancy risk is a function of the number of unprotected and protected sexual encounters:

$$1. \qquad Pr[Pregnancy] = \Phi(u_1, c_1)$$

where u_1 represents the frequency of unprotected sex and c_1 denotes the frequency of protected sex. I assume that the marginal probability of pregnancy increases as either type of sexual activity increases:

$$\Phi_{c_1} > 0 \text{ and } \Phi_{u_1} > 0$$

I also assume that the two separate types of sexual activity have independent effects on the probability of pregnancy:

$$\Phi_{cu} = 0$$

and that protected sexual activity has increasing marginal returns for the probability of pregnancy:

$$\Phi_{cc} > 0$$

Pregnancy risk is not included in the second period of the dynamic model. At this point in time, the decision-maker is an adult, and the implications regarding pregnancy risk and school policy and context are no longer relevant. As such, her decisions, as an adult, regarding sexual frequency, whether unprotected or protected, have no bearing on the predictions from the theoretical model. If pregnancy risk were included in the second period of the model, this would indicate a need for some policy relevant to an adult woman's decisions regarding sexual frequency and contraceptive use, which is outside the scope of this dissertation. In addition, this would imply a three-period model since she would again look forward to the third period consequences of her decisions to determine the optimal levels of sexual frequency and contraceptive intensity in the second period.

In addition to pregnancy risk, there are opportunity costs associated with sexual activity, such as time. The opportunity costs differ for unprotected and protected sexual activity. For example, contracting as STI is one potential opportunity cost of sexual activity; however, the probability of having a STI is higher with unprotected sex than protected sex (with a condom). The opportunity costs associated with unprotected sex are represented by π in the model and the opportunity costs of protected sexual activity are signified by p. Since sexual activity is not delineated by type (unprotected vs. protected) in the second period the opportunity cost of sexual

activity in the second period is π. In addition to the time and money opportunity costs of sexual activity, I also assume that sexual activity as a teenager incurs a psychic cost. For example, the adolescent may experience emotional or reputational damage associated with sexual activity. Since the psychic cost of sexual activity only applies to adolescents, this parameter does not appear in the second period of the model. I let h represent the per encounter psychic cost of sexual activity (regardless of type) to the adolescent, so $hs_1 = h[c_1 + u_1]$ provides the total psychic cost of sexual activity to the adolescent during the first period.

Pregnancy as a teenager likely affects utility in the second period of the model. When considering the future outcomes associated with her current decisions regarding sexual activity and contraception, I assume that the teenager considers how her utility in the future will be affected if she becomes pregnant now compared to if she does not. For example, a teenager may believe she will receive less utility from a bundle of goods in the future if she becomes pregnant as a teenager because her time will be constrained such that she will have less opportunity for leisure. Thus, she may anticipate getting less absolute utility from every unit of the composite good, *x*, and from every unit of sexual activity, *s*, if she has become pregnant than if not. For this reason, I allow utility from consumption of other goods and sexual activity in the future to shift down by the parameter θ if the woman experienced a teen pregnancy. This parameter represents the weight that the adolescent puts on future utility if she were to become pregnant. I assume that this weight ranges between 0 and 1. A value of 0 means that the adolescent believes she will gain no utility from future consumption if she becomes pregnant as a teenager, and a value of 1 means that she believes the utility from consumption in the second period will be unchanged whether she experiences pregnancy as a teenager or not. Structured this way, policies that drive θ toward

1 will be reducing the future utility loss associated with pregnancy as a teenager and policies that drive θ toward 0 will increase the future utility loss associated with pregnancy as a teenager.

The parameter θ is also flexible enough to allow for the cases in which a student actively desires pregnancy. Although I assume that θ ranges between 0 and 1, so that utility in the second period is either unaffected by pregnancy as a teenager or is decreased by pregnancy as a teenager, it is possible that becoming pregnant as a teenager is associated with higher levels of utility in the second period than having not been pregnant as a teenager. This would occur if θ>1. There is evidence that some adolescents desire pregnancy as teenagers (Sipsma, Ickovics et al. 2010). Throughout the discussion of the dynamic model, I assume that θ varies between 0 and 1; however; it may be useful later to consider the subpopulation of students for which pregnancy as a teenager was desired to explore the different impacts school policies might have on this sub-group of students.

I assume that the adolescent is not in the labor market in the first period of the dynamic model. One consequence of this assumption – given that I assume that each sexual encounter takes one unit of time, is that the labor opportunity cost of sexual activity in the first period is zero. In the second period of the dynamic model, there is an wage opportunity cost associated with sexual activity because the adolescent has entered adulthood and is now assumed to be in the labor market. As an adult, total time available for work is defined as $T - s_2$, so any time other than that devoted to being sexually active is available to earn income. Therefore, the opportunity costs of any time spent on s_2 are lost wages. I also assume that pregnancy as a teenager is associated with lower wages as an adult. This could be due to low high school achievement, high school non-completion, or because she chooses to care for her child and delays entering the labor force as an adult. The wage loss associated with pregnancy is

represented as δ, so in the second period, a woman who experienced pregnancy as a teenager would have a wage of $w - \delta$, whereas a woman who did not experience teenage pregnancy would have a wage of w.

Given these considerations, the adolescent's probability of pregnancy can be modeled while taking the dynamic nature of this decision process into account. In the following sections, I present a dynamic model of pregnancy along with some theoretical expectations that stem from the comparative statics.

DYNAMIC MODEL

Consider an adolescent in period one who chooses her current consumption of sexual frequency and contraceptive intensity. These choices result in a level of pregnancy risk; however this risk is not immediately resolved. She enters a period of uncertainty where the pregnancy risk is determined and exits this period as either having experienced pregnancy as a teenager or not. If she was pregnant as a teen, she chooses her consumption in period two subject to a wage penalty and utility shift associated with the pregnancy as a teenager that affect her in the terminal period. If she was not pregnant as a teenager, she chooses her consumption in the second period subject to no wage loss or shift in utility. The adolescent considers the expected utility associated with these two future states of the world when she is making her current decisions about consumption of sexual activity and contraception. Presented graphically, the decision process looks like Figure 1.

The timing of this decision-making process implies a two-step solution strategy. The adolescent considers the future expected utility in period two when making her choices in period one. For this type of decision-process, backwards induction can be used to solve the

maximization problem by starting with the second period and reasoning back to the first period. The process involves solving the utility maximization problem for the second period, first for the outcome of not pregnant as a teenager and second, for the outcome of pregnant as a teenager. A full set of comparative statics are evaluated for each. The next step is to solve the utility maximization problem for the first period, entering the optimal solutions from the second period

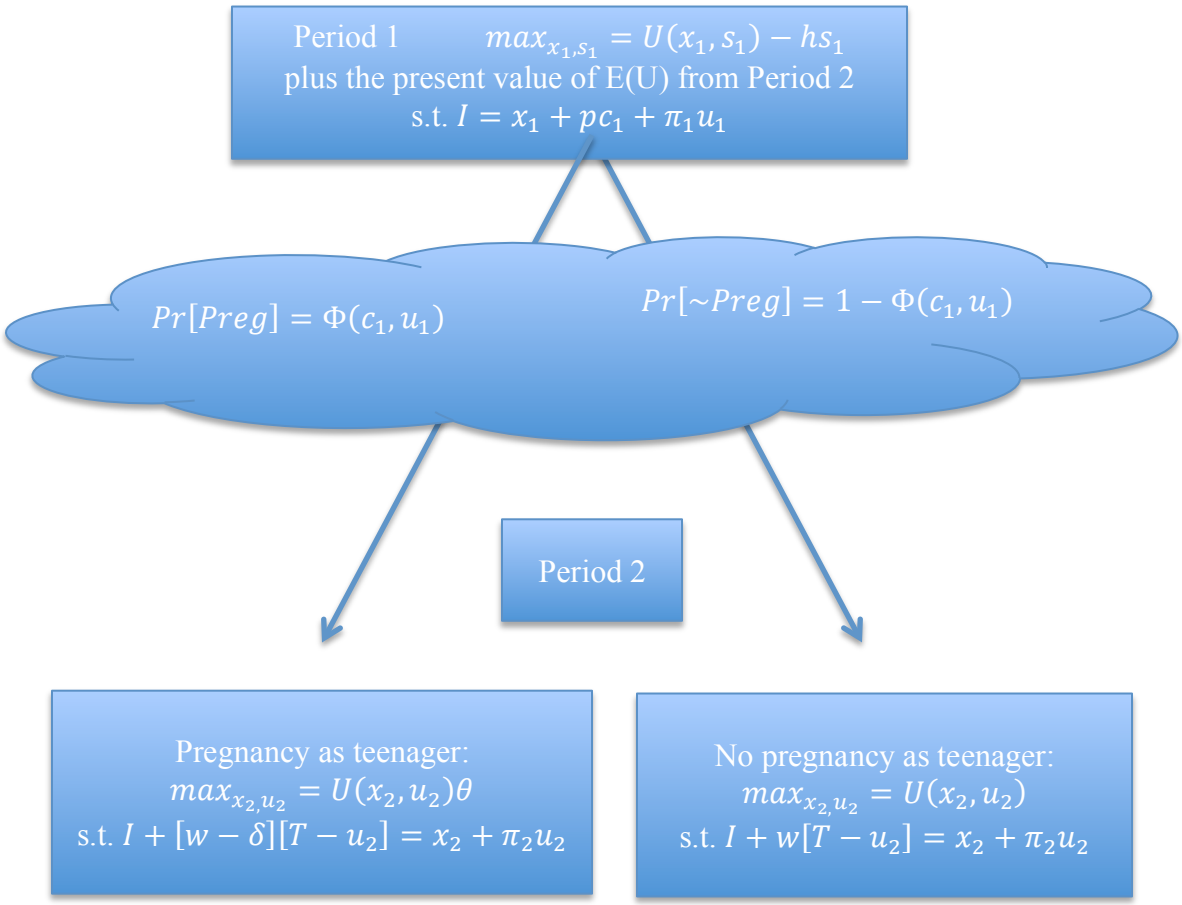

Figure 1: Dynamic Decision Cloud

in as reaction functions in the first period objective function. The comparative statics resulting from this last step are the main predictions of interest. This solution process follows the timing of the choices and payoffs of the adolescent's decision-making process in the dynamic framework since she considers the future implications of her current actions when choosing how much sexual frequency and contraception to consume.

Following this solution strategy, the first step is to solve the optimization problems for the second period. As illustrated in Figure 1, there are two states of the world in period two: "was pregnant" as a teenager and "was not pregnant" as a teenager. The optimization problem the adolescent faces in period two if she was not pregnant as a teenager is:

$$2. \qquad \max_{x_2,u_2,\lambda_2} \mathrm{V}^{\sim \mathrm{P}} = \mathrm{U}(\mathrm{x}_2, \mathrm{u}_2) + \lambda_2[\mathrm{I} + [\mathrm{T} - \mathrm{u}_2]\mathrm{w} - \mathrm{x}_2 - \pi \mathrm{u}_2]$$

where she maximizes her utility of consumption of other goods, x_2, and sex, u_2, subject to a budget constraint. The optimization problem she faces in the second period if she was pregnant as a teenager is:

$$3. \qquad \max_{x_2,u_2,\lambda_2} \mathrm{V}^{\mathrm{P}} = \mathrm{U}(\mathrm{x}_2, \mathrm{u}_2)\theta + \lambda_2[\mathrm{I} + [\mathrm{T} - \mathrm{u}_2][\mathrm{w} - \delta] - \mathrm{x}_2 - \pi \mathrm{u}_2]$$

where, again, where she maximizes her utility of consumption of other goods, x_2, and sex, u_2, subject to a budget constraint. She has an endowment income, *I*. I assume that the only two activities she devotes time to are labor and sexual activity, so the time available for working is her total time, *T*, less the time she spends being sexually active, u_2 , or $[T - u_2]$. Her income is spent in two ways: consumption of x_2 and on the opportunity costs of sexual activity, such as

treating a STI (πu_2). Sexual activity does not incur a direct cost; however, there is also an opportunity cost associated with sexual activity since it takes away from time available for labor. Note that there are two differences between these second period states of the world; the "was pregnant" outcome includes two additional parameters, θ and δ. These parameters represent the two direct costs of teenage pregnancy in the model. The parameter θ is the shift in utility she experiences from being pregnant as a teenager. I assume θ varies between 0 and 1; θ=1 indicates her second period utility from consumption would be completely unaffected by her teenage pregnancy, and θ=0 means that she would receive no utility from consumption in the second period due to experiencing pregnancy as a teenager. The second difference between the "was pregnant" and "was not pregnant" states of the world in the second period is the parameter δ, which represents the wage penalty associated with pregnancy. A teenager who becomes pregnant likely faces challenges to accumulating human capital such as staying in high school, going to college, or deciding whether to go to work or stay at home to care for a young child. For any of these reasons, her wage rate in the terminal period is likely lower than if she had not become pregnant as a teenager.

Based on these two outcomes, the expected utility in period two is the product of the probability that she experiences pregnancy as a teen, $\Phi(c_1, u_1)$, and the utility associated with this outcome, $\mathrm{U}(\mathrm{x}_2, \mathrm{u}_2)\theta$, and the product of the probability that she does not become pregnant as a teen, $1 - \Phi(c_1, u_1)$, and the utility associated with this outcome, $\mathrm{U}(\mathrm{x}_2, \mathrm{u}_2)$:

$$4. \qquad \mathrm{EU}(2) = \Phi(c_1, u_1)[\mathrm{U}(\mathrm{x}_2, \mathrm{u}_2)\theta] + \{1 - \Phi(c_1, u_1)\}\mathrm{U}(\mathrm{x}_2, \mathrm{u}_2)$$

After calculating her expected utility associated with experiencing pregnancy as a teenager or not in the second period, the adolescent considers her utility in the first period. In this period, her utility is a function of other goods, x, and sex, where sex is comprised of a choice between unprotected, u, and protected, c, sexual encounters. Although the opportunity costs of these types of sex differ, I assume that the marginal utility she derives from each kind of sex is the same, or that they are not separable. The optimization problem she faces for the first period is:

$$5. \qquad \max_{x_1,s_1} V = U\,(x_1, u_1 + c_1) - hs_1 + \lambda[I_0 - x_1 - pc_1 - \pi s_1]$$

where she maximizes her utility over consumption of x_1, and s_1, which is comprised of u_1 and c_1, subject to a budget constraint that includes the opportunity costs associated with each type of sexual activity. Sexual activity does incur a direct cost in the first period. For a teenager there may be psychic costs associated with sexual activity such as reputational damage or feelings of guilt. In order to capture this, the model includes a measure of the psychic cost of sexual activity, hs_1. The adolescent has an endowment income in the first period that can be devoted to consumption of x_1 or the opportunity costs of sexual activity, which might include purchasing contraceptives for protected sex or the cost of treating a STI for unprotected sex.

Based on the decision process discussed above, the adolescent maximizes her utility of consumption of sexual activity and other goods in the first period subject to a budget constraint and the present value of the expected utility from the second period. Ultimately, the maximization problem the adolescent faces is:

$$6. \qquad max_{x_1,s_1} = U(x_1, u_1 + c_1) - hs_1 + \beta \begin{Bmatrix} \Phi(u_1, c_1)U(2|P)\theta \\ +[1 - \Phi(u_1, c_1)]U(2|{\sim}P) \end{Bmatrix}$$

where she maximizes utility of consumption from x_1, u_1. and c_1 less the psychic cost she incurs from sexual activity, and she takes the discounted expected utility from the second period into consideration when making her current decisions.

Following the solution strategy outlined above, the process for solving the optimization problem for the dynamic model begins by solving the optimization problem for the two second period outcomes separately: "was not pregnant" $U(2|\sim P)$ and "was pregnant" $U(2|P)$. The process for solving each of the static components of the dynamic model is as follows: 1) satisfy the first order conditions (F.O.C.) by taking the first derivative of the objective function with respect to each of the choice variables and then set them equal to zero 2) solve for the second order conditions (S.O.C.) by taking the second derivative of the objective function with respect to each of the choice variables. This process implies an optimal solution for the choice variables that are a function of the parameters in the model.

The model includes multiple parameters of which the comparative statics could be explored; however, for the purpose of this dissertation, I limit the comparative statics to those focused on the wage penalty associated with pregnancy that the adolescent incurs as an adult, δ, the psychological costs of sexual activity as a teenager, h, and the disutility of teenage pregnancy, θ.

The following sections will solve the second stage of the model, explore the comparative statics for the selected parameters, then input these into the first period as reaction functions. I will then solve for the first period choices regarding the frequency of protected and unprotected sex. Comparative statics from the first stage will describe how these parameters affect adolescent decisions about sexual activity and contraceptive use in light of school policies.

DYNAMIC MODEL-SECOND PERIOD "WAS NOT PREGNANT"

The first step in solving the dynamic utility maximization problem will be to solve the second period outcomes separately. I will first solve the "was not pregnant" second period outcome. The utility maximization problem in period two for the state of the world, "was not pregnant" is:

$$7. \qquad \max_{x_2.u_2,\lambda_2} V^{\sim P} = U(x_2, u_2) + \lambda_2[I + [T - u_2]w - x_2 - \pi u_2]$$

Notice that x_2 can be defined in terms of other variables in the model:

$$x_2 = f(u_2) = I + [T - u_2]w - \pi u_2$$

or

$$x_2 = f(u_2) = I + [-w - \pi]u_2 + wT$$

which implies that the utility function can be rewritten in terms of one choice variable, u_2, instead of as a function of u_2 and x_2. The optimization problem for $U(2|\sim P)$ then becomes:

$$7a. \quad \max_{u_2} V^{\sim P} = U(f(u_2), u_2)$$

Following the solution process for utility maximization, I first find the F.O.C. for the objective function by taking the first derivative with respect to the sole remaining choice variable in the model, u_2. and setting this derivative equal to zero to satisfy requirement for utility maximization:

$$\frac{\partial \mathrm{V}^{\sim \mathrm{P}}}{\partial \mathrm{u}_2} = \frac{\partial \mathrm{U}}{\partial \mathrm{f}(\mathrm{u}_2)} \times \frac{\partial \mathrm{f}(\mathrm{u}_2)}{\partial \mathrm{u}_2} + \frac{\partial \mathrm{U}}{\partial \mathrm{u}_2}$$

or:

$$\frac{\partial \mathrm{V}^{\sim \mathrm{P}}}{\partial \mathrm{u}_2} = \mathrm{U}_\mathrm{x}[-\mathrm{w} - \pi] + \mathrm{U}_\mathrm{u} = 0$$

The S.O.C. are satisfied by taking the first derivative of the F.O.C. with respect to u_2 (which is the second derivative of the objective function):

$$\mathrm{V}_{\mathrm{uu}} = \left[\frac{\partial \mathrm{U}_\mathrm{x}}{\partial \mathrm{f}(\mathrm{u}_2)} \times \frac{\partial \mathrm{f}(\mathrm{u}_2)}{\partial \mathrm{u}_2} + \frac{\partial \mathrm{U}_\mathrm{x}}{\partial \mathrm{u}_2}\right][-\mathrm{w} - \pi] + \frac{\partial \mathrm{U}_\mathrm{u}}{\partial \mathrm{u}_2} + \frac{\partial \mathrm{U}_\mathrm{u}}{\partial \mathrm{f}(\mathrm{u}_2)} \times \frac{\partial \mathrm{f}(\mathrm{u}_2)}{\partial \mathrm{u}_2}$$

$$V_{uu} = \mathrm{U}_{\mathrm{xx}}[-\mathrm{w} - \pi]^2 + 2\mathrm{U}_{\mathrm{xu}}[-\mathrm{w} - \pi] + \mathrm{U}_{\mathrm{uu}} < 0$$

Satisfying the S.O.C. ensures utility is maximized and implies that the optimal choice for sexual activity, u_2^*, exists and is a function of the parameters in the model, $u_2^{*\sim P} = u_2^{\sim P}(w, \pi, I)$. Now that this optimal functionale for $u_2^{\sim P}$ has been defined, I insert this into the F.O.C. which is then

definitionally equal to zero. I differentiate this optimized F.O.C. with respect to the parameters of interest to explore the comparative statics. Inserting $u_2^{*\sim}$ into the F.O.C. provides:

$$\frac{\partial \mathrm{V}^{\sim \mathrm{P}}}{\partial u_2^*} = \mathrm{U_x}\left(f\left(u_2^*(w,\pi,I)\right), u_2^*(w,\pi,I)\right)[-w-\pi]$$

$$+\mathrm{U_u}\left(f\left(u_2^*(w,\pi,I)\right), u_2^*(w,\pi,I)\right) \equiv 0$$

The comparative statics can be found by differentiating the optimized F.O.C. with respect to the parameters in the model. In this case, $u_2^{*\sim P}$ is a function of wage, expected cost of STI treatment, and income, or $u_2^{*\sim P} = u_2^{\sim P}(w,\pi,I)$.

Comparative Statics

Period 2 Wage

The first comparative static of interest is for the wage parameter. In the second period of the model, the wage parameter represents actual wages. The comparative statics for expected wages will be explored when solving the first period since this is when she is looking forward to the impact of today's decisions on her expected outcomes in Period 2. The comparative static for wage and sexual frequency in the second period where there was no pregnancy as a teenager is:

$$8. \qquad \frac{\partial \mathrm{u_2^*}}{\partial \mathrm{w}} = \frac{\mathrm{U_u}}{\mathrm{V_{uu}}} + [\mathrm{T} - \mathrm{u_2^*}]\frac{\partial \mathrm{u_2^*}}{\partial \mathrm{I}} \gtrless 0$$

This comparative static indicates that in the second period, an increase in the wage rate may be associated with an increase or a decrease in sexual activity. This is a "Slutsky-type" equation, with substitution and income effects that offset one another. The effect of a change in wage on sexual frequency is the same as the traditional labor-leisure tradeoff. In this model, I make the assumption that the only activity, other than labor, that time can be devoted to is sexual activity, which is analogous to leisure in the labor-leisure tradeoff model. For this reason, the effect of a change in income, or wage, on sexual activity is ambiguous. This is because the substitution effect is always negative; however the income effect may be negative or positive due to the backward bending supply curve of labor. However, *w* represents the opportunity cost of sexual activity, since all remaining time not spent on s is available for labor. In general when the opportunity cost rises, the amount of time devoted to sexual activity should decrease. For this reason, it is likely that $\frac{\partial \mathrm{u}_2^*}{\partial \mathrm{w}} < 0$.

Future wage is the only parameter of interest in the second period of the dynamic model for the "was not pregnant" outcome. I only care about the comparative static for wage because the parameters I will ultimately be analyzing that appear in the second period are wage and the wage penalty associated with pregnancy. The latter does not appear in the "was not pregnant" outcome, so the only comparative static of interest for this Period 2 outcome is for the wage parameter. The next step in the solution process is to solve the objective function for the second period outcome "was pregnant" and the relevant comparative statics for w and δ.

DYNAMIC MODEL-SECOND PERIOD "WAS PREGNANT"

The utility maximization problem in period two for the state of the world "was pregnant" is:

$$9. \qquad \max_{x_2.u_2} V^P = U(x_2, u_2)\theta + \lambda[I + [T - u_2][w - \delta] - x_2 - \pi u_2]$$

Notice that x_2 can be defined in terms of other variables in the model:

$$x_2 = f(u_2) = I + [T - u_2][w - \delta] - \pi u_2$$

which implies that the utility function can be rewritten in terms of one choice variable, u_2, instead of as a function of u_2 and x_2. The optimization problem for $U(2|P)$ then becomes:

$$9a. \quad \max_{u_2} V^P = U\Big(f\big(u_2(I, w, \pi, \delta, \theta)\big), u_2(I, w, \pi, \delta, \theta)\Big)$$

Following the solution process for utility maximization, I first find the F.O.C. for the objective function by taking the first derivative with respect to the sole remaining choice variable in the model, u_2. and setting this derivative equal to zero to satisfy the requirement for utility maximization:

$$\frac{\partial V^P}{\partial u_2} = \left[\frac{\partial U}{\partial f(u_2)} \times \frac{\partial f(u_2)}{\partial u_2} + \frac{\partial U}{\partial u_2}\right]\theta$$

$$\frac{\partial \mathrm{V^P}}{\partial \mathrm{u_2}} = \{\mathrm{U_x}[\delta - \mathrm{w} - \pi] + \mathrm{U_u}\}\theta = 0$$

The S.O.C. are satisfied by taking the first derivative of the F.O.C. with respect to u_2 (which is the second derivative of the objective function):

$$\mathrm{V_{uu}} = \left\{\left[\frac{\partial \mathrm{U_x}}{\partial \mathrm{f(u_2)}} \times \frac{\partial \mathrm{f(u_2)}}{\partial \mathrm{u_2}} + \frac{\partial \mathrm{U_x}}{\partial \mathrm{u_2}}\right][\delta - \mathrm{w} - \pi] + \frac{\partial \mathrm{U_u}}{\partial \mathrm{u_2}} + \frac{\partial \mathrm{U_u}}{\partial \mathrm{f(u_2)}} \times \frac{\partial \mathrm{f(u_2)}}{\partial \mathrm{u_2}}\right\}$$

$$V_{uu} = \{\mathrm{U_{xx}}[\delta - \mathrm{w} - \pi]^2 + 2\mathrm{U_{xu}}[\delta - \mathrm{w} - \pi] + \mathrm{U_{uu}}\}\theta < 0$$

Satisfying the S.O.C. ensures utility is maximized and implies that the optimal choice for sexual activity, u_2^*, exists and is a function of the parameters in the model, $u_2^{*P} = u_2^P(w, \pi, I, \delta, \theta)$. Now that this optimal functionale for u_2^{*P} has been defined, I insert this into the F.O.C. which is then definitionally equal to zero. I then differentiate this optimized F.O.C. with respect to the parameters of interest to explore the comparative statics. Inserting u_2^{*P} into the F.O.C. provides:

$$\frac{\partial \mathrm{V^P}}{\partial u_2^*} = \mathrm{U_x}\left(f\left(u_2^*(w, \pi, I, \delta, \theta)\right), u_2^*(w, \pi, I, \delta, \theta)\right)[-w - \pi]$$

$$+\mathrm{U_u}\left(f\left(u_2^*(w, \pi, I, \delta, \theta)\right), u_2^*(w, \pi, I, \delta, \theta)\right) \equiv 0$$

The comparative statics can be found by differentiating the optimized F.O.C. with respect to the parameters in the model. In this case, u_2^{*P} is a function of wage, expected cost of STI treatment, and income, or $u_2^{*P} = u_2^P(w, \pi, I, \delta, \theta)$.

Comparative Statics

Period 2 Wage

The comparative static for wage in the second period "was pregnant" outcome indicates that a change in wage has an ambiguous effect on sexual activity:

$$10. \qquad \frac{\partial u_2^*}{\partial w} = \frac{U_x \times \theta}{V_{uu}} + [T - u_2^*] \frac{\partial u_2^*}{\partial I} \gtrless 0$$

Note, that this is a Slutsky-type equation in that it contains an always-negative substitution effect and an income effect that may be negative or positive, which produces an ambiguous comparative static. However, it is likely that this effect is negative since w represents the opportunity cost of sexual activity, and when the opportunity cost of an activity increases, there generally should be a decrease in the time devoted to that activity.

Period 2 Wage Penalty Associated with Pregnancy

In this second period outcome, there is also a wage penalty associated with pregnancy as a teenager, which is one of the direct costs of teenage pregnancy. The comparative static for wage loss is also ambiguous.

$$11. \qquad \frac{\partial u_2^*}{\partial \delta} = \frac{-U_x \times \theta}{V_{uu}} - [T - u_2^*] \frac{\partial u_2^*}{\partial I} \gtrless 0$$

This is also a Slutsky-type equation with an income and substitution effect; however in this case, the substitution effect is positive. This is because as δ rises, the opportunity cost of sexual

activity falls. Thus, increasing δ is a decrease in the opportunity cost of time devoted to sexual activity – so the positive substitution effect is expected. Again, although the prediction from the comparative static is ambiguous, like wage, δ represents the opportunity cost of sexual activity as well. When the wage loss associated with pregnancy as a teenager increases, the opportunity cost of sexual activity decreases, which should increase sexual activity. For this reason, it is likely that the comparative static for $\frac{\partial u_2^{*P}}{\partial \delta}$ is positive.

Period 2 Disutility Associated with Teenage Pregnancy

The disutility associated with teenage pregnancy also appears in the second period of the model for the "was pregnant" outcome. However, notice that the F.O.C. equals:

$$12. \qquad \frac{\partial V^P}{\partial u_2} = \{U_x[\delta - w - \pi] + U_u\}\theta = 0$$

Since both sides can be divided by θ, canceling θ from the right-hand side, then the comparative static with respect to θ is equal to zero. This implies that behaviorally there are no effects of θ, conditional on the fact that she was pregnant as a teen. Recall the discussion from before regarding θ simply being a one-time downward shift in utility.

Now that the relevant comparative statics for each static component of the second period have been complete, the differences between these two outcomes can be explored. The following section will consider how the difference in utility between the Period 2 outcomes may change with respect to the parameters of interest.

DIFFERENCES IN EXPECTED UTILITY IN SECOND PERIOD (Δ)

Taken independently, the comparative statics from the second period of the dynamic model do not directly inform the probability of experiencing pregnancy as a teenager because the effects focus on the impact of a change in a parameter in the model on sexual frequency in the second period. However, when considered together, the comparative statics inform understanding how the probability of pregnancy is ultimately affected by the parameters in the model, since the second period comparative statics can be used to find the difference in utilities between the two states of the world in the second period. When choosing sexual frequency and contraceptive intensity in the first period, the adolescent will consider the differences in second period utility associated with the implied probabilities of pregnancy from each choice. In other words, the comparative statics for the parameters from $V_2^{\sim P}$ and V_2^{P} can be compared to predict the total difference in utility for the outcome "was not pregnant" as a teenager and "was pregnant" as a teenager. The total utility change associated with being pregnant as a teenager can be represented as:

$$13. \qquad \Delta = \mathrm{U}(2|\mathrm{P})\theta - \mathrm{U}(2|{\sim}\mathrm{P})$$

where the utility change associated with experiencing pregnancy as a teenager, Δ, is the utility in the second period given pregnancy as a teenager, $\mathrm{U}(2|\mathrm{P})$, scaled by the parameter for the utility loss associated with pregnancy as a teenager, θ, minus the utility in the second period given no pregnancy as a teenager, $U(2|\sim P)$.

In order to sign Δ, consider what the likely effects of experiencing pregnancy as a teenager are on x_2 and u_2. In principle, the effects on consumption of x_2 and u_2 in the second

period are ambiguous in the "was pregnant" and "was not pregnant" outcomes. I cannot definitively say what happens to consumption of x_2 and u_2 when teenage pregnancy occurred, but I can consider what is most likely. If the "was pregnant" path was followed, then the opportunity cost of sexual activity is lower relative to the "was not pregnant" outcome because the time devoted to labor in the "was pregnant" outcome results in a lower return since one of the direct costs of pregnancy as a teenager is a lower wage rate as an adult. Because time is therefore less valuable in the "was pregnant" outcome, it follows that $u_2^P > u_2^{\sim P}$. This implies the marginal utility of consumption of u_2 in the "was pregnant" outcome is less than for the "was not pregnant" outcome: $U_u(P) < U_u(\sim P)$. It also follows that higher u_2^P and lower net wages for the "was pregnant" path would decrease consumption of other goods such that $x_2^P < x_2^{\sim P}$, which implies the marginal utility of x_2 is higher for the "was pregnant" outcome than for the "was not pregnant" outcome: $U_x(P) > U_x(\sim P)$. Knowing that the marginal utility of u_2 is higher is the "was pregnant" outcome but that the marginal utility of x_2 is lower in the "was pregnant" outcome does not help sign Δ.

However, the shift of utility associated with teenage pregnancy, θ, must also be considered. For example, if θ=1, then it will be unclear how utility in the "was pregnant" outcome differs from utility in the "was not pregnant" outcome since the marginal utility of u_2 is less in the "was pregnant" outcome than the "was not pregnant" outcome, but the marginal utility of x_2 is greater in the "was not pregnant" outcome than the "was pregnant" outcome. However, it is likely that θ < 1 for the majority teenagers who become pregnant, which means that teenage pregnancy negatively influences future utility. Given this possibility, it is probable that the second period utility for the "was pregnant" path is shifted down enough such that utility is higher in the "was not pregnant" outcome. In general, this means that utility in the "was

pregnant" path will be lower than utility in the "was not pregnant" path, which would make $\Delta = U(2|P)\theta - U(2|{\sim}P) < 0$, assuming $0 < \theta < 1$. I will explore the comparative statics for Δ under this assumption.

Comparative Statics

The parameter Δ plays an important role in the adolescent's current decisions regarding sexual frequency and contraceptive intensity since she uses this comparison of her future utility in both possible states of the world (pregnant as a teenager or not) to inform her current decisions regarding behaviors determine her pregnancy risk (sexual frequency and contraceptive intensity). The comparative statics for Δ are interesting because they predict how changes in parameters, such as wage, in the second period affect the adolescent's expected utility associated in the second period. The comparative statics for Δ can be found by differentiating Δ with respect to each of the parameters in the model.

Period 2 Wage

The first comparative static of interest is for wage. An adolescent's expectation for her future wage is likely to influence her current risk-taking behaviors. If she has high expectations for future income, she may be less likely to engage in behaviors that undermine these expectations. In this scenario, an increase in future wages would be associated with an increase in Δ. Expectations for higher wages in the future would be associated with a greater loss in utility if she experiences pregnancy as a teenager. On the other hand, if she does not have clear expectations regarding her future income, there may be less of an influence on her current decisions due to ambivalence about her future economic outcomes. Also, an adolescent may

have expectations for lower future wages. If this is the case, she may not perceive the wage penalty from pregnancy in the second period as a large negative outcome.

To find the comparative static for the effect of wage on Δ, take the derivative of Δ with respect to w:

$$14. \qquad \frac{\partial \Delta}{\partial w} = \left[\frac{\partial U^{P}}{\partial u_2} \times \frac{\partial u_2^{P}}{\partial w}\right] \theta - \frac{\partial U^{\sim P}}{\partial u_2} \times \frac{\partial u_2^{\sim P}}{\partial w} \gtrless 0$$

Although $U_u^P < U_u^{\sim P}$, and the comparative statics for wage for both the "pregnant" and "not pregnant" outcomes are positive, the relative magnitude of $\frac{u_2^{*P}}{\partial w}$ and $\frac{u_2^{\sim P}}{\partial w}$ is unclear, so the sign for the comparative static for Δ and w is ambiguous.

Wage Penalty Associated with Pregnancy

In addition to wage, another important parameter affecting utility in the second period is the wage penalty associated with pregnancy. As previously discussed, a teenager who becomes pregnant likely has fewer opportunities to invest in human capital than teenagers who did not experience pregnancy. This lower investment in human capital probably results in a second period wage loss associated with pregnancy as a teenager, δ. For example, if a teenager becomes pregnant and drops out of high school to care for her child, she will most likely have lower wages as an adult compared to a teenager who did not become pregnant and completed high school. In addition, a teenager who has a child also has a different opportunity cost of labor as an adult than a teenager who does not have a child. For this reason, I expect that an increase in the wage loss associated with pregnancy as a teenager should increase the difference in utility

between the "was pregnant" and "was not pregnant" outcomes in the second period. The comparative static for Δ with respect to the wage loss associated with pregnancy, δ is:

$$15. \qquad \frac{\partial \Delta}{\partial \delta} = \left[\frac{\partial U^{P}}{\partial u_2} \times \frac{\partial u_2^{P}}{\partial \delta}\right]\theta - \frac{\partial U^{\sim P}}{\partial u_2} \times \frac{\partial \tilde{u_2}^{P}}{\partial \delta} = \left[\frac{\partial U^{P}}{\partial u_2} \times \frac{\partial u_2^{P}}{\partial \delta}\right]\theta \gtreqless 0,$$

since $\frac{\partial \tilde{u_2}^{P}}{\partial \delta} = 0$.

The comparative static for Δ and δ is ambiguous; however if δ is considered as an opportunity cost of sexual activity, then as the wage loss associated with pregnancy as a teenager increases, the opportunity cost of sexual activity should decrease which in general implies $\frac{\partial u_2^{P}}{\partial \delta} > 0$. If this assumption is correct, then $\frac{\partial \Delta}{\partial \delta}$ should be positive. This implies that as the wage loss associated with pregnancy as a teenager increases, the difference in utility between the "was pregnant" and "was not pregnant" outcomes will increase.

Disutility Associated with Teenage Pregnancy

Another important parameter that affects utility in the second period is the disutility of pregnancy as a teenager, θ. The comparative static for Δ with respect to θ is:

$$16. \qquad \frac{\partial \Delta}{\partial \theta} = U(2|P) > 0$$

This indicates that as θ gets bigger, or the disutility from pregnancy is higher, the difference between utility in the second period for the "was pregnant" and "was not pregnant" outcomes grows.

Now that the comparative statics for the second period of the dynamic model have been fully explored, these can be used in solving the comparative statics of interest in the first period of the model.

DYNAMIC MODEL-FIRST PERIOD

The next step in solving the dynamic utility maximization problem will be to solve the first period outcome. The utility maximization problem in period one is:

$$17. \qquad max_{x_1,s_1} V^1 = U(x_1, u_1 + c_1) - hs_1 + \beta \begin{Bmatrix} \Phi(u_1, c_1)U(2|P)\theta \\ +[1 - \Phi(u_1, c_1)]U(2|{\sim}P) \end{Bmatrix}$$

Recall that unlike the second period, in the first period, I assume that the teenagers choose between protected and unprotected sexual activity. Here u_1 denotes unprotected sexual encounters and c_1 represents protected sexual encounters. Thus, the adolescent is maximizing her utility as a function of other goods, unprotected sex, and protected sex.
Notice that x_1 can be defined in terms of other variables in the model:

$$\mathrm{x}_1 = \mathrm{g}(\mathrm{s}_1) = I - pc_1 - \pi u_1$$

which implies that the utility function can be rewritten in terms of one choice variable, s_1, which is comprised of u_1 and c_1, instead of as a function of two choice variables. The optimization problem for the first period then becomes:

$$15a. \quad max_{x,s_1} V^1 = U(g(s_1), u_1 + c_1) - hs_1 + \beta\{U(2|{\sim}P) + \Phi(u_1, c_1)\Delta\}$$

where $\Delta \equiv U(2|P)\theta - U(2|{\sim}P) < 0$ if $\theta < 1$. Recall that $U(2|P)$ is a function of $u_2^{*P}(I, w, \delta, \pi, \theta)$ and $U(2|{\sim}P)$ is a function of $u_2^{*{\sim}P}(I, w, \pi)$.

Following the solution process for utility maximization, I first find the F.O.C. for the objective function by taking the first derivative with respect to the two remaining choice variables in the model, u_1 and c_1, and setting these derivatives equal to zero to satisfy the requirement for utility maximization:

$$\frac{\partial V^1}{\partial u_1} = -U_x\pi + U_s - h + \beta\Phi_{u_1}\Delta = 0$$

and

$$\frac{\partial V^1}{\partial c_1} = -U_x p + U_s - \mathrm{h} + \beta\Phi_{c_1}\Delta = 0$$

Satisfying the S.O.C. ensures utility is maximized and implies that the optimal choices for sexual frequency and contraceptive intensity, u_1 and c_1, exist and are a function of the parameters in the model, $u_1^* = u_1(h, p, \pi, I, w, \delta, \theta, \beta)$ and $c_1^* = c_1(h, p, \pi, I, w, \delta, \theta, \beta)$. Now that these optimal functionales for u_1 and c_1 has been defined, I insert these into the F.O.C., which are then definitionally equal to zero. I then differentiate these optimized F.O.C. with respect to the parameters of interest to explore the comparative statics. Inserting u_1^* and c_1^* into the F.O.C. provides:

$$\frac{\partial V^1}{\partial u_1} = U_x\left(f\left(s_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right), u_1^*(h,p,\pi,I,w,\delta,\theta,\beta) + c_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right)\pi$$

$$+U_s\left(f\left(s_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right), u_1^*(h,p,\pi,I,w,\delta,\theta,\beta) + c_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right)$$

$$-h + \beta\Phi_{u_1}\Delta \equiv 0$$

Inserting c_1 into the F.O.C. provides:

$$\frac{\partial V^1}{\partial c_1} = U_x\left(f\left(s_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right), u_1^*(h,p,\pi,I,w,\delta,\theta,\beta) + c_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right)p$$

$$+U_s\left(f\left(s_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right), u_1^*(h,p,\pi,I,w,\delta,\theta,\beta) + c_1^*(h,p,\pi,I,w,\delta,\theta,\beta)\right)$$

$$-h + \beta\Phi_{c_1}\Delta \equiv 0$$

Comparative Statics

Period 1 Expected Wage Loss Associated with Pregnancy

The effect of experiencing pregnancy as a teenager on future labor market outcomes likely plays a role in an adolescent's current decisions regarding unprotected and protected sexual activity. If she believes the future wage penalty associated with pregnancy as a teenager to be high, she might be less likely to engage in sexual activity without contraceptives in order to avoid pregnancy. The labor market outcome in this model is the wage loss she expects to incur if she becomes pregnant as a teenager, δ.

The comparative static for unprotected sexual activity and the expected wage loss associated with pregnancy indicates that an increase in the wage loss associated with pregnancy, δ, may increase or decrease sexual frequency:

$$18. \quad \frac{\partial u_1}{\partial \delta} = |H|^{-1}\beta\Delta_\delta\{\Phi_c[U_{xx}p\pi - U_{xs}[\pi + p] + U_{ss}] - \Phi_u[U_{xx}p^2 - 2U_{xs}p + U_{ss} + \Phi_{cc}\beta\Delta]\} \gtrless 0$$

Although the comparative static is ambiguous, it is possible to consider what might make the relationship between δ and u_1 signable. Recall that Δ_δ is likely positive. The discount factor, β, and $|H|^{-1}$ are also positive in sign. I assume that as protected sexual activity increases, the probability of pregnancy increases, or that Φ_c is positive, but $[U_{xx}p\pi - U_{xs}[\pi + p] + U_{ss}]$ is negative, which makes this first term negative. This portion of the comparative static indicates that as the expected wage penalty associated with pregnancy increases, unprotected sexual activity would decrease, which is what would generally be expected. So, what might make this comparative static positive? The term $[U_{xx}p^2 - 2U_{xs}p + U_{ss} + \Phi_{cc}\beta\Delta]$ is ambiguous in sign. The first portion of the term is negative, so when it is multiplied by $-\Phi_u$, which is also negative, it becomes positive. However, $\Phi_{cc}\beta\Delta$ is positive in sign, so when this is multiplied by $-\Phi_u$, it becomes negative, which is in line with what would be expected for this comparative static. This indicates that the problematic portion of this comparative static, or the portion that may result in a positive relationship between the expected wage penalty associated with teenage pregnancy and unprotected sexual activity, is $U_{xx}p^2 - 2U_{xs}p + U_{ss}$. This portion of the comparative static could drive the positive relationship if the negative portion of the second term, $\Phi_{cc}\beta\Delta$, was too small to offset this positive component. The term $\Phi_{cc}\beta\Delta$ would be small if the adolescent had a

low discount factor, β, which implies that she heavily discounts the future. In fact, if the discount factor is low enough, the model may be limited to one period, which, in that case, the positive relationship between unprotected sexual activity and the expected wage penalty associated with pregnancy is no longer applicable, since she does not look forward and consider the expected effect of her current decisions on her future outcomes. Additionally, if Δ, which indicates that she does not believe that her future utility would be significantly affect by experiencing a teenage pregnancy. Although a positive relationship between the expected wage penalty associated with pregnancy and unprotected sexual activity seems counterintuitive, exploring the comparative static more fully illustrates that this outcome could obtain for present-oriented adolescents, teenagers who believe getting pregnant would not greatly affect their future utility, or individuals sharing both characteristics.

The comparative static for the expected wage loss associated with pregnancy and protected sexual activity is also ambiguous in sign:

$$19. \quad \frac{\partial c_1}{\partial \delta} = |H|^{-1}\beta\Delta_\delta\{-\Phi_c[U_{xx}\pi^2 - 2U_{xs}\pi + U_{ss} + \Phi_{uu}\beta\Delta] + \Phi_u[U_{xx}p\pi - U_{xs}[\pi + p] + U_{ss}]\} \gtrless 0$$

Again, the term $|H|^{-1}\beta\Delta_\delta$ is positive. Also, the second term in the brackets is negative, which is what would be expected, or as the expected wage penalty associated with teenage pregnancy increases, sexual activity, even protected sex, would most likely decrease in order to mitigate the risk of pregnancy. The rationale for how this comparative static might be positive follows the explanation of the comparative static for unprotected sexual activity and δ. The portion of the first term that is negative is $-\Phi_c[\Phi_{uu}\beta\Delta]$, so again, for the comparative static to be positive

$-\Phi_c[U_{xx}\pi^2 - 2U_{xs}\pi + U_{ss}]$ must outweigh $-\Phi_c[\Phi_{uu}\beta\Delta]$, which would occur if this term were small. Again, this term would be small for present-oriented adolescents who believe that the impact of becoming pregnant as a teenager on their future utility to be small.

Period 1 Psychic Cost Associated with Teenage Sexual Activity & Disutility Associated with Teenage Pregnancy

Given that the comparative statics for the expected wage penalty were made ambiguous in sign, this can be extrapolated to the comparative statics for h and θ. The comparative statics for these parameters will also be ambiguous. This is true because, given the symmetric nature of the Hessian matrix, one portion of the comparative statics for these parameters always will be negative and the other positive, thus resulting in an ambiguous sign. That being said, it is important to consider how changes in these parameters might have positive or negative impacts on unprotected and protected sexual activity.

For example, if the psychological cost of sexual activity as a teenager increases, overall you would expect a decrease in protected and unprotected sex. However, for an individual who continues to be sexually active, you might expect an increase in protected sex relative to unprotected since this mitigates some of the potential psychological costs such as anxiety resulting from STI risk. This implies that as the psychological cost of sex as a teenager increases, unprotected and protected sex should go down, but that the ratio of protected to unprotected sex might increase.

Also, if the expected disutility associated with teenage pregnancy increases, this might also increase or decrease either type of sex. For example, if the expected disutility of teenage pregnancy gets higher, then you would expect both types of sex to decrease. However, again, it

may be that for sexually active students this change in the expected disutility associated with teenage pregnancy could simply shift to more protected sexual encounters.

BRINGING IT ALL TOGETHER: THE EFFECT OF SCHOOL POLICIES ON PREGNANCY RISK

The risk of pregnancy as a teenager, given optimal choices from this two period model, is determined by the choice regarding the combination of unprotected and protected sex, $\Phi(c,u)$. Together, these determine the probability that an adolescent experiences pregnancy:

$$Pr[Preg] = \Phi(c,u).$$

The ultimate goal of this model is to explore how different school policy levers change the likelihood that an adolescent becomes pregnant, which involves calculating the comparative statics for the probability of pregnancy and the parameters in the model.

Comparative Statics

Period 1 Wage Penalty Associated with Pregnancy

The comparative static for the expected wage loss associated with pregnancy is also ambiguous:

$$20. \qquad \frac{\partial Pr[Preg]}{\partial \delta} = \Phi_c \times \frac{\partial c_1}{\partial \delta} + \Phi_u \times \frac{\partial u_1}{\partial \delta} \gtrless 0,$$

which indicates that a change in the expectation for the wage penalty associated with teenage pregnancy has an indeterminate effect of pregnancy probability. The relationship between the wage penalty associated with pregnancy and sexual frequency is likely negative for adolescents who have high $\Phi_{cc}\beta\Delta$ and $\Phi_{uu}\beta\Delta$. If this effect spills over to their contraceptive behaviors, then increasing the expected wage penalty associated with pregnancy for students who are future-oriented, have access to effective contraceptives, and/or believe that being pregnant as a teenager would negatively affect their future utility would most likely decrease their pregnancy risk. Again, this protective result probably does not hold for students who do not share these characteristics.

Again, given that the comparative statics for $\frac{\partial c_1}{\partial h}$, $\frac{\partial u_1}{\partial h}$, $\frac{\partial c_1}{\partial \theta}$, and $\frac{\partial u_1}{\partial \theta}$ are ambiguous in nature, the comparative statics for $\frac{\partial Pr[Preg]}{\partial h}$ and $\frac{\partial Pr[Preg]}{\partial \theta}$ will also be ambiguous in sign. Although the comparative statics were all ambiguous in nature, this framework can still be used to guide thinking about expectations regarding the effects of changes in these parameters of interest on sexual choices and ultimately pregnancy risk. This exercise also serves a useful purpose in providing a framework for further empirical analyses in the following chapters.

CONCLUSION

In summary, the dynamic theoretical model aims to characterize the adolescent's decision-making process regarding sexual frequency and contraceptive intensity using economic neoclassical decision theory. The dynamic nature of the model considers a teenager who is currently maximizing her consumption of other goods and sexual activity subject to a budget constraint and the present value of the expected utility from the second period. The comparative statics of interest for the dissertation include the expectation for future labor market outcomes,

including the wage penalty associated with teenage pregnancy, the psychological cost of sexual activity as a teenager, and the expected disutility of teenage pregnancy. The comparative statics on unprotected sex, protected sex, and change in pregnancy risk for the first period are completed for all of these parameters. Given some assumptions regarding a sub-group of students who have high discount factors, access to effective contraceptives, and beliefs that pregnancy would negatively impact expected utility in the future, the comparative statics on the parameters of interest indicate that increasing these expectations may decrease sexual frequency (both protected and unprotected) and ultimately pregnancy risk, for this sub-group of students. It is also possible that it may have the opposite effect. Although, many of the predictions are ambiguous, given some assumptions regarding characteristics of different sub-groups of students, the comparative statics are informative regarding the expected consequences of changes in the parameters of interest.

CHAPTER 4

THE EFFECT OF SCHOOL POLICIES ON PREGNANCY RISK

INTRODUCTION

In this chapter, I focused on how three school policies related to reproductive health (school-linked daycares, school provided family planning services, and requiring separate schooling for pregnant students) affected student sexual behaviors that put them at risk for pregnancy. These policies could be potentially endogenous; for example, if an unobservable variable, such as community religiosity, is predictive of the school's propensity to adopt one of these policies and is also predictive of student sexual choices, then this would introduce endogeneity bias. I discuss a method for addressing this econometric issue later in the chapter. This analysis is a direct extension from my theoretical model, which examined how students make decisions about behaviors that determine their pregnancy risk. Recall from Chapter 3, that I am interested in studying how students make decisions about frequencies of protected and unprotected sex and that I assumed they are rational decision-makers who maximize their utility across both types of sexual activity.

For this chapter, I directly tested how school policies related to reproductive health might intervene on these decisions by modeling the effect of daycare, family planning services, and separate schooling policies on female high school student sexual behaviors that put them at risk for pregnancy. One component of pregnancy risk is the decision to be sexually active, so I first modeled the effect of these policies on whether female students had any sex. Conditional on

being sexually active, the two components of pregnancy risk include sexual frequency and contraception (as discussed in Chapter 3). I modeled these behaviors separately, but I also wanted to take into account that these decisions occur simultaneously to ultimately determine pregnancy risk. In order to capture this, I created a set of sexual strategies that included seven different choices characterized by sexual frequency and contraceptive use that correspond to varying degrees of pregnancy risk.

DATA

Description

I used data from the National Longitudinal Study of Adolescent Health (Add Health) for this analysis. Add Health originated from a congressional mandate to fund a study on adolescent health. The Add Health study began in 1994 and was funded by grants from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and a host of other federal agencies and foundations. It is the largest panel study of adolescents conducted to date. The study began with a nationally representative in-school survey of over 90,000 students in grades 7-12 in 1994. The study continued with four waves of in-home surveys of a nationally representative sub-sample of these 90,000 students (approximately 20,000 were sampled in the first wave (Center)) in 1994-95; 1996; 2001-02; and 2007-08. The first two waves focused on areas that would influence adolescent risk-taking behaviors whereas the final two waves focused on adolescents transitioning into adulthood. The study contains information from supplemental surveys of parents, siblings, peers, school administrators, and romantic partners. The respondents were also geocoded which allowed each respondent's data to be linked with already collected contextual data about their communities (Center ; Center ; Chantala 2006).

The Add Health was administered in 80 high schools and 52 middle schools that were chosen from 80 communities across the country. The 80 high schools that were chosen were nationally representative of schools in the United States based on region, urbanicity, size, type, and ethnic composition and were chosen from a sampling frame of 26,666 schools. The participation rate for the 80 original selected schools was over 70 percent. Replacement schools were selected from the same stratum for schools that declined. The selected high schools were asked to each identify a feeder school, which was a middle school that sent at least five students to the high school. For high schools that included the 7th grade, a feeder school was not identified. In total 52 feeder schools were identified, resulting in a 132 schools in the study (Chantala 2006).

For this analysis, I used data from Wave 1 of the Add Health study. The respondents were between 7-12th grades. Wave 1 of the Add Health consists of several surveys. The first is the in-school questionnaire, which was administered to over 90,000 students between September 1994-April 1995. Parents were given the choice to opt their children out of the survey. The in-school portion of Wave 1 included the following topics:

- "social and demographic characteristics of respondents
- education and occupation of parents
- household structure
- risk behaviors
- expectations for the future
- self-esteem
- health status
- friendships

- school-year extracurricular activities (Center)."

For this analysis, I did not use data from the in-school survey because it did not include questions about sexual behaviors, which is the focus of my dissertation.

However, Wave 1 also included a more detailed in-home questionnaire. Students who participated in the in-school survey or who were on the school roster were included in the sampling frame for the in-home survey. The students selected for the in-home questionnaire were interviewed between April and December of 1995. The interviews were conducted using laptop computers. For some topics, the interviewer asked the respondent questions aloud. For other topic areas, including sexual behaviors, the respondents listened to questions though headphones and recorded their own answers (Center ; Chantala 2006). The in-home questionnaire included questions on:

- "health status
- health-facility utilization
- nutrition
- peer networks
- decision-making processes
- family composition and dynamics
- educational aspirations and expectations
- employment experience
- the ordering of events in the formation of romantic partnerships
- sexual partnerships
- substance use
- criminal activities (Center)."

In addition to the in-home questionnaire, Wave 1 also collected supplemental information including school administrator and parent surveys as well as a contextual dataset that was constructed from pre-existing data collected by agencies such as the US Census and Centers for Disease Control and Prevention (CDC) data, and the Federal Bureau of Investigation, for example; this contextual data was matched to youth responses based on geocoded information from each student's address on the in-home survey (Center ; Center). The contextual data include information on:

- "geographic and household characteristics
- labor force participation and unemployment
- income and poverty
- social integration/disintegration
- availability and utilization of health services
- social programs and policies
- crime (Center)."

There were 132 schools that responded to the administrator surveys, and these questionnaires surveyed administrators about school policies, including healthcare and referrals, teacher demographics, and student characteristics. The school administrator survey was conducted during the 1994-1995 school year (Center).

The parent questionnaire was conducted for parents of students selected for the in-home survey and covered areas including:

- "inheritable health conditions
- marriages and marriage-like relationships
- neighborhood characteristics

- involvement in volunteer, civic, and school activities
- health-affecting behaviors
- education and employment
- household income and economic assistance
- parent-adolescent communication and interaction
- parent's familiarity with the adolescent's friends and friends' parents (Center)."

Inclusion / Exclusion Criteria

Although approximately 20,000 students were selected for the Wave 1 in-home interview (Center), after accounting for missing data for all of the independent variables in this analysis, the in-home sample dropped to 9,932 respondents (including male and female students). Since I was interested in the potential spillover effects of school polices related to reproductive health on student sexual behaviors, I limited my analysis to female students who had not experienced a pregnancy as of Wave 1. A spillover effect is an effect that is felt by someone who is not directly (yet) affected by the policy; for example, a spillover effect would exist if the presence of a daycare were to change the decision making of students who do not yet have a child.

Dropping males reduced the 9,932 respondents by about half. I also excluded 295 females who had already experienced pregnancy as of the first wave. These exclusions result in a final sample of 4,842 never-pregnant (as of Wave 1), female students for the analysis. The potential for introducing selection effects from this restriction appears minimal since 295 female students had experienced pregnancy prior to Wave 1 and 231 female respondents experienced high school pregnancy after Wave 1. Thus students continued to become pregnant at about the same rate after eliminating the already pregnant respondents from the sample.

I used survey weights to account for the stratified sampling design, which I will explain in further detail below; however, an important note is that although the subpopulation of never-pregnant female students I have identified totals 4,482 respondents, correctly adjusting for the stratified sampling design requires that Stata use the non-restricted sample when estimating the models. Once missing data for the independent variables are accounted for, the non-restricted sample totals 9,932 respondents and includes all male and female students (even those who had experienced pregnancy as of Wave 1). Further discrepancies in observations among the models in this analysis are due to missing data for the respective outcome variables of interest. Analyzing this sample will allow me to ultimately identify spillover effects on sexual frequency and contraceptive use for sexually active female students or effects on initiation and contraceptive use for students who were not sexually active.

Survey Design

Since I focused my analysis on the in-home sample, I will limit my discussion of the sampling design and survey weighting techniques for the Wave 1 in-home sample. The Add Health used a clustered sampling design, which resulted in unequal probability of selection for respondents. This sampling design must be corrected for using survey weights or it may result in biased estimates, mainly by attenuating standard errors (Chantala 2006).

The clustered sample was selected as follows: 132 schools were selected from a sampling frame of 26,666 schools identified in the National Quality Education Database (QED). The schools were selected with probabilities proportional to enrollment (schools with more students had a higher probability of being sampled), which created an almost self-weighting sample for the approximately 90,000 students selected for the in-school survey. Of these students, 27,599

were recruited to participate in the in-home portion of the study. This sample consists of a core group of 16,044 students in addition to a saturation (near complete) sample from 16 schools and oversamples of certain groups of students. The core sample was selected based on grade-sex stratum. The Wave 1 in-home survey oversampled high-income African American students, Chinese students, Cuban students, Puerto Rican students, and disabled students. For a subset of 16 schools, all of the students were chosen for in-home interviews. There was also a genetic sample in which sibling pairs, twins, and half siblings were all included in the in-home sample. This genetic sample also consisted of non-related siblings living in the same household, for example adopted siblings.

Because of the stratified sampling design, survey weights are necessary to correct for the differential probability of selection of respondents. The survey weights correct for the oversampling of certain groups, non-response, and deviations in the sample population from the total population. Stata 12 includes survey design commands to account for complex sampling designs and allow for correct use of survey weights. In order to use the Add Health weights properly, it is important to specify the design type, which in this case is with replacement. Stata's default design type is with replacement when "survey setting" the data.

The first step in using the survey weights in Stata is to "survey set" the data. To do this, I specified the primary sampling unit, weight, and stratum variables using Stata's 'svyset' command. Since this analysis was cross-sectional, I used the grand sample weight for Wave 1. This generates a nationally representative sample of students in grades 7-12. Although any respondents missing the grand sample weight would be excluded from any regression analysis, it is important to drop all students who are missing this weight prior to analysis so that they are not included in descriptive analyses.

Finally, when analyzing a subset of the sample, in this case, never-pregnant female students, using survey weights, only keeping respondents in the specified group is incorrect since Stata needs to be able to adjust for all of the primary sampling units in order to weight the data correctly. Thus, estimation on the appropriate group was accomplished using the 'subpop' command in Stata. The subpopulation I analyzed was never-pregnant, female students. Using the survey weights and identifying the subpopulation correctly generates a nationally representative sample for this analysis (Chantala and Tabor 1999; Chantala 2006)

Creating Outcome Variables

For this chapter, I focused on how school policies related to the reproductive health of students might affect behaviors that put them at risk for pregnancy, including sexual activity, sexual frequency, and contraceptive use. I measured both sexual frequency and contraceptive use in the 1995 school year and created a variable to capture pregnancy risk by including a sexual frequency component and a contraception component. Thus, I had four outcome variables of interest: 1) any sexual activity in the school year; 2) school year sexual frequency; 3) any birth control use during the school year; and 4) pregnancy risk during the school year (sexual strategies). The second and third outcomes are conditional on reporting sexual activity.

In order to create these variables, I used data from the Add Health relationship files. The respondents were asked to identify up to three people that they have had romantic relationships with and were then asked detailed questions about these relationships. Additionally, respondents who reported sexual activity with someone who was not a romantic partner were asked to report up to three people who fell into this category and were then asked detailed information about these relationships. Thus, a total of up to six relationships could have been reported (three

romantic and three non-romantic) for each respondent. For the identified relationships, the respondents were asked a series of questions that are relevant to this analysis.

First, they were asked whether or not they had sexual intercourse with the partner. If so, they reported the start and end dates of the sexual relationships. Depending on the length of the relationship, respondents were asked different sets of sexual behavior questions. If they only had sex once, they were asked if they used any form of birth control at that occurrence and then were asked to list up to three types of birth control. For respondents whose sexual relationships happened more than once but lasted less that a month, questions included whether they used any birth control during the relationship and what types (up to three options); however they were not asked about sexual frequency. Relationships that lasted longer than a month were asked to report any birth control use during the relationship, the type of birth control (up to three options), and sexual frequency. For all relationships, regardless of length, they were asked if they used any method of birth control ever and then asked to choose up to three methods.

Identifying School-Year Relationships

Before discussing how the individual outcome variables were constructed, I will discuss why and how I limited relationships to those occurring only in the Wave 1 school year. First, since I was focused on how school policies affected student sexual risk-taking behaviors, I wanted to make sure I only measured sexual behaviors that were contemporaneous to policies in the Wave 1 school year. The sexual behavior variables I used to create the outcomes were from the relationship files in the in-home survey. The relationship information asked respondents to identify relationships that were active over the previous 18 months. In some cases, these relationships extended before or beyond the 1994-1995 school year. Given the 18-month look-

back period of the questions in the relationship files, the relationships could have been going on before or after the school year began. Thus, it was important to carefully identify relationships, or the parts of relationships, that occurred only during the Wave 1 school year.

This is a critical point because the school administrator surveys were conducted within the scope of the 1994-1995 school year, so the school policy variables in this analysis were for that school year only. For this reason, I wanted to make sure that the sexual behaviors I measured occurred during the 1994-1995 school year as well. The in-home surveys were conducted between April 1995-December 1995. A student interviewed in December 1995 would be asked to report about relationships over the past 18 months, which would encompass the 1994-1995 school year but also could include information about relationships before the school year began or after it was over.

In order to address this issue, I first dropped relationships that ended before the start of the 1994-1995 school year and relationships that started after the 1994-1995 school year ended. To identify the remainder of the relationships that occurred during the school year, I calculated how many days of the reported relationship actually took place during the school year.

The respondents were asked to report start and end dates for up to six relationships. Using this and the start and end dates of the school year, I was able to identify the days of a relationship that occurred during the school year. I assumed that the school year started on August 1, 1994 and ended on April 30, 1995. The in-home interviews, which included the relationship information, began in April of 1995 and lasted until December of 1995. Because of this, using these start and end dates for the school year should have captured all relevant relationships. I opted to be conservative with the end of the school year (April, 1995) because if the end date

was after April, then students who were interviewed in April would not be able to report information in their relationships that occurred in May, for example.

For relationships that began and ended within the school year, the length of their relationship was the number of relationship days in the school year. If relationships spanned part of the school year or more than the school year, I kept only the part that occurred during the school year. I top-coded the number of days of each of the six possible relationships at the 95th percentile of the number of observed days to account for outliers. To calculate the number of days the relationship lasted in the school year, I used the following decision rules (where SD=start date and ED=end date):

1. School year days=Relationship ED-School year SD if Relationship SD<School year SD & Relationship ED<School year ED
2. School year days=School year ED-Relationship SD if Relationship SD>School year SD & Relationship ED>School year ED
3. School year days=School year ED-School year SD_3 if Relationship SD<School year SD & Relationship ED>School year ED
4. School year days=Relationship length if Relationship SD>School year SD & Relationship ED<School year ED
5. School year days=1 if sex happened once & Relationship SD>School year SD & Relationship ED<School year ED
6. School year days=15 if Relationship<month & Relationship SD>School year SD & Relationship ED<School year ED

The first three rules captured the days of the relationship that occurred during the school year for those relationships that either started before the school year, ended after the school year, or both.

The fourth rule captured relationships that were contained within the school year. The fifth rule captured relationships that consisted of only one sexual encounter and occurred within the school year. Finally, the sixth rule identified relationships where sex occurred more than once, but the relationships lasted less than a month. For this last set of relationships, I only knew that they lasted less than a month, so I assumed that these relationships lasted an average of 15 days and only kept those that occurred during the span of the school year. Thus the behaviors I modeled as a function of school policies were only measured during the school year in which the policy was in place.

Outcome 1: Any Sexual Activity

The first outcome variable of interest for this chapter was a dichotomous indicator variable that equaled 1 if the respondent reported sexual activity with a partner and 0 otherwise. The respondents were asked to identify a series of occurrences that happened in each relationship, one of which was sex. If they indicated that sex occurred, they were then asked a second clarification question about if the sexual activity was vaginal intercourse. This variable equals a 1 if they answered yes to the follow-up question and a zero otherwise. I only kept positive responses for respondents who indicated that the sexual activity occurred during the school year using the same decision rules detailed above.

Outcome 2: Sexual Frequency during School Year

The second outcome variable of interest was school year sexual frequency. I created this variable using information on sexual frequency during the relationship and the number of school year days in the relationship. I top-coded sex frequency at the 95th percentile for each of the (up

to six) relationships to account for outlying observations (for example, a handful of respondents reported nearly 1,000 sexual encounters for one relationship during the approximately 280 day school year).

Recall that sexual frequency is known for relationships that consisted of one encounter or for those that lasted longer than a month; however, frequency was not asked for respondents who reported more than one sexual encounter in a relationship that lasted less than a month. I imputed values for these individuals by taking the average frequency for respondents who were in relationships longer than a month (so that sexual frequency was reported) but whose relationship lasted 60 days or less. I divided this number by two to get the monthly average sex frequency for respondents who were in relationships between one and two months in length. I used this average as the sex frequency for respondents who were in a relationship that lasted less than a month but consisted of more than one sexual encounter. I created this average separately for each relationship, since the average frequency differed greatly across the (up to) six different relationships on which each respondent could report.

In order to get the sexual frequency in the school year, I took the total sexual frequency and divided it by the number of days in the relationship to create a sex per day variable for each relationship. I then multiplied the sex per day for each respondent's relationship by the number of relationship days that occurred during the school year to produce the school year frequency. I did this for each respondent for up to six relationships and then summed across an individual respondent's relationship(s) to get her total school year sex frequency.

Outcome 3: Birth Control Use during School Year

The third outcome of interest in this analysis was birth control use conditional on sexual activity. The relationship files asked respondents about birth control use with each partner listed. All respondents who reported sexual activity with a relationship partner (romantic or non-romantic) were asked if they used any form of birth control and if so, to list up to three forms of birth control used. With this information I created an indicator variable for whether the respondent reported any birth control use. I limited these to more effective birth control options. I included the following as legitimate methods of birth control:

- Condoms
- Birth control pills
- IUD
- Vaginal ring
- Depo Provera

The following were listed as options for the respondents to choose from; however, these are generally less efficacious methods of birth control relative to the ones I included, so I did not count these as legitimate responses (Trussell 1995):

- Withdrawal
- Rhythm
- Vaginal sponge
- Foam, jelly, cream, suppositories
- Diaphragm, with or without jelly
- Some other method

As long as the respondent reported any birth control use and at least one of the options was legitimate, this variable was set equal to one. Respondents who did not report any birth control, or respondents who reported birth control but did not list a legitimate option, were coded as a zero for the any birth control variable. I aggregated this variable within person, across relationships as well, so if a respondent reported any birth control use in any of her relationships, then she was coded as a one. Regrettably, this is a crude measure of birth control use; however, it was the most accurate measure possible given data limitations. Again, I only included responses to this question for relationships that occurred during the school year, using the same decision rules previously discussed.

Outcome 4: Sexual Strategies

At this point, I had compiled information about sexual activity, sexual frequency, and any birth control use for each respondent across up to six relationships. I wanted to aggregate this information into one variable that characterized the respondent's pregnancy risk. I created a final outcome variable for this analysis which was a categorical variable of sexual strategies the students chose from that put them at varying risks of pregnancy. This outcome measure related directly back to the theoretical model in Chapter 3 which focused on predicting pregnancy risk as a function of protected and unprotected sex frequency. Differing levels of sexual frequency and birth control use produce varying levels of pregnancy risk. One can imagine that these students take this risk into consideration when making decisions about sexual frequency and contraceptive use.

In order to capture pregnancy risk as an outcome, I created a categorical variable that measured student decisions about sexual frequency and contraceptive use. I assumed that a

student chose between a set of sexual strategies, some of which put them at higher risk for pregnancy than others. Each strategy was characterized by a school year sexual frequency (low, medium, or high) and contraceptive use (none or some). I identified low sexual frequency at the 25th percentile, medium frequency at between the 25th and 75th percentiles, and high frequency at greater than the 75th percentile, conditional on sexual activity. I broke the sexual frequency measure into these categories because these were natural cut points in the data. The 25th percentile included school year sex frequencies ranging from one to 3.14 sexual encounters. The 25th to 75th percentile ranged from at least 3.15 to 28.52 encounters, and greater than the 75th percentile included over 28.52 encounters in the school year. I explored other cut-points for my categorical variable, and my findings were robust to varying specifications. Just as each respondent's sexual relationship history could be characterized by frequency, I was also able to characterize each history as either using no contraception at all or some contraception. Again, I limited contraceptives to more effective types identified in the previous discussion regarding the construction the birth control outcome variable. Using this information on sexual frequency during the school year and contraceptive use, I created a set of sexual strategies that included seven possible combinations of frequency and contraceptive options. These strategies are not inherently ordered since choosing medium frequency and no birth control does not necessarily put a student at lower risk than choosing high frequency and some birth control. The table below illustrates how these eight categories were constructed using information on school year sexual frequency and contraceptive use:

		Contraceptive Use	
		None	*Some*
Sexual Frequency	*None*	1	n/a
	Low	2	3
	Medium	4	5
	High	6	7

Figure 4.1: Sexual Strategies

For example, a female respondent who was not sexually active would be coded as a 1 for this categorical variable. A student who had more than 28.52 (>75th percentile) sexual encounters in the school year and used no birth control would be coded as a 6, whereas a student in the high frequency group who reported some birth control use would be coded as a 7.

The table below includes the seven different categories and their frequency distributions:

	Sexual Strategy	**n=4,726**	**Percent**
1.	No Sex	3,601	84.21
2.	Low Sex / No BC	31	0.72
3.	Low Sex / BC	131	3.06
4.	Medium Sex / No BC	12	0.28
5.	Medium Sex / BC	275	6.43

6.	High Sex / No BC	61	1.43
7.	High Sex / BC	165	3.86

Figure 4.2: Sexual Strategy Frequencies

Independent School Policy Variables

The independent variables of interest for this analysis were a set of school policies related to student reproductive health including: 1) school-linked daycare; 2) school-linked family planning services; and 3) requiring a pregnant student to attend a separate school (or home schooling). Each of these policies presumably could affect pregnancy risk either by altering the cost of teenage pregnancy directly or indirectly by changing the cost of behaviors that lead to pregnancy.

There are several parameters in the theoretical model in Chapter 3 that could be affected by these policies, which could in turn affect pregnancy risk. One set of parameters focused on future income and the expected income penalty associated with pregnancy. School-linked daycare might affect pregnancy risk through these parameters. For example, if a student knows she will be able to remain in school and continue to accumulate human capital if she becomes pregnant because her school offers childcare, this may reduce the cost of pregnancy in such a way that leads her to either increase her sexual frequency, decrease birth control use, or both - thereby increasing her pregnancy risk. Separate schooling could have the opposite effect. This policy could be viewed as punitive and may decrease sexual risk taking behaviors by increasing the cost of teenage pregnancy since the student would be forced to leave school.

Two other relevant parameters from the theoretical model are the psychological cost of sexual activity as a teenager and the disutility of teenage pregnancy. Both of these may be reduced if policies such as offering daycare or family planning services work to destigmatize teenage pregnancy or sexual risk taking. For example, if a school has a daycare, this might signal that teenage pregnancy is more acceptable and lead to decreased psychological costs of sex and lower anticipated disutility from pregnancy, which could ultimately lead to behaviors that increase pregnancy risk. On the other hand, keeping teenage mothers in school through daycares may serve to increase the disutility associated with teenage pregnancy if non-pregnant students hear from parenting teens about how difficult being a teenage mother can be. This peer effect could decrease pregnancy risk. A school that offers family planning services is likely relatively progressive with regard to sexual and reproductive health. Such policies may partially destigmatize sexual activity and pregnancy in such a way as to decrease the psychological cost of sexual activity as a teenager or the expected disutility associated with teenage pregnancy. This could induce students to engage in activities that increase pregnancy risk. Finally, requiring separate schooling would likely increase the psychological cost of sexual activity as a teenager and the disutility of teenage pregnancy by stigmatizing pregnancy, which could lead to behaviors that decrease pregnancy risk. These policies could affect sexual and contraceptive behaviors that determine pregnancy risk through multiple pathways identified in the theoretical model.

I created these school policy variables using information from the Wave 1 Administrator survey. One administrator from each school participating in the study responded to a survey that asked about school characteristics, including detailed information regarding school policies. For the daycare and family planning service questions, the administrators were asked if the school provided each of these and in what capacity. More specifically, the administrator chose between

four options: 1) provided on school premises; 2) provided by the district (at another school); 3) referred to other providers; and 4) neither provided nor referred. I used this information to create a dichotomous indicator variable for whether or not the school offered either of these services to students. The daycare and family planning services variables are equal to 1 if either the school or district provided the service (i.e., if the administrator said "yes" to either 1) provided on school premises *or* 2) provided by the district (at another school)) and equal to 0 otherwise. The separate schooling variable is a dichotomous indicator variable where a 1 indicates that pregnant students were required to attend separate schools (including home schooling) and a zero if this requirement was not in place. The variables do not generally appear to be highly correlated with each other and therefore seem to be measuring separate policies:

	Daycare	Family Planning	Separate Schooling
Daycare	1.0000		
Family Planning	0.4547	1.0000	
Separate Schooling	-0.0471	-0.0907	1.0000

Figure 4.3 Correlation Matrix of Policy Variables

Control Variables

Since sexual behaviors are complex, I included control variables at the individual, family, and community level. I controlled for demographic, socioeconomic, cultural, and community characteristics including; age, race/ethnicity income, immigrant status, parent's education, family structure, welfare receipt, religiosity, self-perceived overweight status, school size, urbanicity,

and region. For a more detailed description of the control variables included, please see Appendix A.

Descriptive Statistics

Descriptive statistics are reported in Table 4.1 below. Almost 26 percent of never-pregnant female students reported being sexually active at Wave 1. Of the sexually active students, the average school year sex frequency was 39.33 and 82.3 percent of sexually active students reported at least some birth control use during the school year. The average age of the respondents is approximately 15 years. Since the summary statistics in Table 4.1 are at the individual level, I also calculated descriptive statistics separately at the school level. Out of 127 schools in the sample, 15.7 percent had a school-linked daycare, 3.9 percent provided family planning services, and 33.9 percent required separate schooling for pregnant students.

METHODS

Conceptual Model Overview

Recall from Chapter 3, that I assumed individual youth made deliberate choices about sexual activities by weighing the costs and the benefits of those choices and allowed for school policies to play a role in this process. To operationalize this theoretical model, I assumed that each student maximizes utility from a combination of protected and unprotected sex frequencies, which determines her pregnancy risk. In operationalizing the theoretical model for this empirical application, I assumed that utility depends on observable characteristics of the youth (X^{O}_{is}), school policies (P_s), and observable school characteristics (S^{O}_{s}), and school-specific environmental and cultural influences – which we will assume for the moment are unobservable

(S^U_s). If there were unobservable factors that were significant predictors of behavior, and correlated with my policy variables of interest, then my models would be subject to endogeneity bias. For this chapter (and for Chapter 5 that follows), I estimated two sets of models: one assuming policy exogeneity and one assuming policy endogeneity. In this section I provide the specifications for first the exogenous models and then the endogenous models. I used an approach for the endogenous models that allowed me to test for the statistical importance of any potential endogeneity bias by testing for the significance of the unobservables in my models. Ultimately, I found that the presence of endogeneity bias was not supported by the data and thus relied on the models that assume policy exogeneity for my main results.

Recall that for this chapter, I modeled four outcome variables related to sexual decisions that determine pregnancy risk: 1) any sexual activity; 2) school year sex frequency conditional on sexual activity; 3) any contraceptive use conditional on sexual activity; and 4) sexual strategy (7 potential combinations of sex frequency and contraceptive use).

Exogenous Models

The model predicting any sexual activity was estimated using a probit, since the outcome was dichotomous in nature, where:

$$1. \qquad Pr\left[any\_sex_{i,s}\right] = \Phi\left(X^O_{is}\beta + S^O_s\beta_s + P_s\beta_P\right)$$

Note that there are no unobservables present in this equation and thus no source of endogeneity.

Once a student has decided to be sexually active, then she must decide her sexual frequency. Since this is a continuous measure of frequency, it can be modeled using OLS regression where school year frequency is:

$$2. \qquad School\ year\ sex\ frequency_{i,s} = X_{is}^{O}\beta + S_{s}^{O}\beta_s + P_s\beta_s + \varepsilon_i$$

Also, sexually active students must decide whether or not to use birth control. Again, this choice will be made by selecting the option that maximizes her expected utility. Since use of any birth control is dichotomous in nature it will be modeled using a probit regression:

$$3. \qquad Pr\left[any\_birthcontrol_{i,s}\right] = \Phi\left(X_{is}^{O}\beta + S_{s}^{O}\beta_s + P_s\beta_P\right)$$

Although it is interesting to model the different components of pregnancy risk, I am ultimately interested in estimating how these policy variables affect pregnancy risk itself, which is a function of *both* sexual frequency and birth control use. In order to capture pregnancy risk, I created a categorical variable of sexual strategies that put respondents at different level of pregnancy risk based on their joint sexual frequency and birth control choices. In this case, the choice is more complex and inherently non-ordered because there is no latent index value that crosses multiple thresholds such that the value associated with one sexual strategy should be higher than the other. For example, it is unclear whether medium sexual frequency with no birth control puts an individual at higher or lower risk for pregnancy than high sex frequency with some birth control. For this reason, I modeled these sexual strategies using a multinomial logit

where *j* indexes the strategy chosen. In this case the probability that the student chooses the j^{th} sexual strategy option is:

$$4. \qquad Pr[y_{j,i,s} = j] = \frac{e^{X_{is}^{O}\alpha_{j,O} + S_{s}^{O}\alpha_{j,O} + P_{s}\alpha_{j,P}}}{1 + \sum_{j=1}^{7} X_{is}^{O}\alpha_{j,O} + S_{s}^{O}\alpha_{j,O} + P_{s}\alpha_{j,P}}$$

Here, $y_{j,i,s,t}$ represents the observed sexual strategy decision. This is the classic Random Utility Model of McFadden (1974) and was estimated using a multinomial logit.

Econometric Issue - Endogeneity

I also wanted to address the possibility that the school policies I am interested in were endogenous. These school policies might be endogenous if, for example, a school with high rates of teenage pregnancy was more likely to offer family planning services. If a school has high rates of teenage pregnancy, this might lead them to offer family planning services in an attempt to decrease teenage pregnancy in the school by increasing contraceptive use. This could lead to endogeneity bias since the relationship between pregnancy risk and the policy variable would be the result of the schools with higher pregnancy rates selecting into family planning services, for example, due to some unobservable third variable that influences both the policy and student behavior. Ultimately, I do not find evidence of policy endogeneity in these models; however, in the following sections I will discuss how I tested for endogeneity and how the method I used would control for school-level policy endogeneity.

Consider a general model of individual behavior that is intrinsically non-linear (in this case, either any sex, any birth control use, or sexual strategy:

$$5. \qquad y_{is} = M\left(X_{is}^{O}\beta + S_s^{O}\beta_s + P_s\beta_P + S_s^{U}\beta_U\right) + \varepsilon_{is}$$

recall that:

- y_{is} is the non-linear sexual behavior choice (discussed above) for the i^{th} youth in school *s*;
- X_{is}^{o} are the observable characteristics of the individual youth;
- P_s are (potentially) endogenous policies of school *s* that affect the individual's sexual choices;
- S_s^{O} are observable characteristics of school *s*;
- S_s^{u} are unobservable characteristics of school *s* that are correlated with P_s .

For my purposes, P_s are the policies set by the school. These will be determined in part by such things as the culture of sexuality of the students in the school, which are part of X_s^{u}. Given that, for example, this culture of sexuality also affects the choices of the individual students, then X_s^{u} is also an important predictor of y_{is}. However, since X_s^{u} is unobservable by assumption, it must be omitted in any actual regression of (5) above. Thus in actual empirical application, I can only estimate:

$$6. \qquad y_{is} = M\left(X_{is}^{O}\beta + S_{s}^{O}\beta_{s} + P_{s}\beta_{P}\right) + \varepsilon_{is}$$

and since by assumption P_s is correlated with X_s^u the estimated parameters on the policies will be biased from the omitted variables such that $p\lim\hat{\beta}_P \neq \beta_P$.

Instrumental Variables for School Policy Unobservable Variables

For this reason, researchers often opt for instrumental variables as the solution to the problem of omitted unobservable school variables that would (in my model) influence both P_s (school policies) and y_{is} (youth sexual behavior). If it were possible to obtain some estimate of the X_s^u to include in the regression model such that (5) could be estimated directly, then bias could be avoided. One approach to this is to use Two-Stage Residual Inclusion (2SRI), which is the version of 2SLS that is consistent for non-linear models. It is important to note that the residual inclusion method is also consistent for linear models. For this reason, I used this technique for the school year sexual frequency model as well, which was estimated using OLS. 2SRI corrects endogeneity from omitted variables by estimating X_s^u and then including these consistent estimates in the equation of interest, which for me is equation (5).

To see how this method works, recall that any two correlated variables can be related to each other if there is a third variable that is correlated with one (and not the other), as

$$7. \qquad P_{is} = r(z_{is}\alpha) + S_{s}^{u}$$

where r(.) is a linear or non-linear correlation term.

Here $z_{is} = \left[\begin{array}{ccc} X_{is}^{o} & S_{s}^{O} & w_{c} \end{array} \right]$ is a vector containing both the observable variables in the behavioral model at the individual level, X_{s}^{O}, and school levels, S_{s}^{O}, as well as the community level variables that serve as instruments, w_{c} (which are at the county level in the data); the instruments must satisfy the requirements that they are:

1. uncorrelated with S_{s}^{u},
2. "strong" instruments, and
3. excludable from (5).

The instruments that I used for the 2SRI portion of the analysis are from the Add Health contextual data files. These data included detailed information about respondents' counties and neighborhoods. Each student is assigned contextual data based on her residential address. It may be that one school has students from separate counties; however since the first stage of the model is predicted using the student as the unit of observation, this should capture the school community as a whole, regardless of whether the students live in different counties. For this instrumental variable approach, I needed at least one instrument for each potentially endogenous policy variable. I chose instruments that should be indicative of community support for these types of policies but not be predictive of the individual youth's sexual behaviors. Since I had three policy variables, I needed at least three instruments. The instruments included: 1) family planning clients aged 20-44 per women aged 20-44 - county; 2) conservative denomination adherents per capita - county; 3) proportion voting republican in 1992 presidential election - county; and 4) proportion of local government direct general expenditures for education - county. Each of these should be predictive of the school's propensity to have a daycare, offer family

planning services, or require a pregnant student to attend a separate school but should not predict an individual student's choices about sexual behaviors.

For example, the number of family planning clients aged 20-44 per women aged 20-44 in the county should be predictive of demand for reproductive health services in the community (but not in school-aged individuals). This demand should in turn be predictive of the propensity for these communities to offer services like school-linked daycare and family planning services, or to have more punitive policies such as requiring a pregnant student to attend a separate school. The proportion of family planning clients that are adult women should not be predictive of any individual (non-adult) student's sexual choices. Both the proportion of the county population that are religiously conservative and the proportion that voted Republican in the last presidential election should be indicative of general social norms in the community that affect the likelihood that schools have policies that are more tolerant of teenage sexual / activity and pregnancy (family planning services and daycare) or that the school has a less tolerant policy (separate schooling for pregnant students). Although these variables measure general cultural norms in the community, they should not be predictive of any individual student's sexual behaviors. The proportion of local government expenditures directed to education should also be predictive of a school's ability to offer family planning services, daycare, and separate schooling. Each of these services likely taps into the school's budget. Schools receiving a greater amount of funding from the local government may be more likely to have ancillary programs such as these. Again, education expenditures should not be predictive of any individual student's sexual behavior choices. For more details on these conditions see (Terza, Basu et al. 2008; Terza, Bradford et al. 2008).

2SRI Estimation of Endogenous Policies

This model is implemented in two stages. In the first-stage, the instruments and the predictors from the behavioral regression are regressed on each policy variable. Then, the predicted residuals, which capture the school-level unobservables, are recovered from the first-stage regressions and included in the second stage behavioral regressions to control for omitted unobservables that would cause endogeneity bias for the policy variables of interest. 2SRI also provides a direct test of policy endogeneity. If the predicted residuals are jointly statistically significant in the second-stage regression, this indicates the presence of policy endogeneity. In the following section, I provide more detail regarding this instrumental variables method.

In the first stage, since the efficiency with which the α are estimated is not at issue, we can assume that (7) is linear and proceed by considering the first stage regression equation:

$$4. \qquad P_{is} = z_{is}\alpha + S_s^u$$

Once we recover estimates of α note that $\hat{P}_{is} = z_{is}\hat{\alpha}$ so that

$$P_{is} - \hat{P}_{is} = z_{is}\alpha + S_s^u - z_{is}\hat{\alpha} = S_s^u \equiv \hat{\upsilon}_s$$

and as long as (8) is correctly specified where $\alpha = \hat{\alpha}$ then

$$5. \qquad \hat{\upsilon}_s = S_s^u$$

In other words, the residual from this first stage regression is an estimate of the school-level unobservables that are the root of the problem in estimating (5).1 Including $\hat{v}_s$ in the model for (5) thereby corrects the omitted variable problem (if it is truly present) and allows unbiased estimates of the coefficients.

The second stage of the model thus proceeds by estimating the augmented maximum likelihood estimators for

1. $$Pr\left[any\_sex_{i,s}\right] = \Phi\left(X_{is}^{O}\beta + S_s^{O}\beta_s + P_s\beta_P + \hat{v}_s\right)$$

2. $$School\ year\ sex\ frequency_{i,s} = X_{is}^{O}\beta + S_s^{O}\beta_s + P_s\beta_P + \hat{v}_s + \varepsilon_i$$

3. $$Pr\left[any\_birthcontrol_{i,s}\right] = \Phi\left(X_{is}^{O}\beta + S_s^{O}\beta_s + P_s\beta_P + \hat{v}_s\right)$$

4. $$Pr\left[y_{j,i,s} = j\right] = \frac{e^{X_{is}^{O}\alpha_{j,O} + S_s^{O}\alpha_{j,O} + P_s\alpha_{j,P} + \hat{v}_s}}{1 + \sum_{j=1}^{7} X_{is}^{O}\alpha_{j,O} + S_s^{O}\alpha_{j,O} + P_s\alpha_{j,P} + \hat{v}_s}}$$

which are then free from endogeneity bias. They are also free of omitted variables bias associated with missing school-level variables. As a technical note, unlike 2SLS in linear models, 2SRI requires that the actual values of P_s (not the predicted values) be included in (10) - (13) along with the predicted $\hat{v}_s$.

1 I recognize that there may still be individual-level (student) unobservables present (such as risk preferences) in the second stage error term. Since I only have instruments for the community-level unobservables, an augmented version of (5) will not correct for the individual level omitted variables. However, the first stage residual will still correctly capture all school unobservables and so control the endogeneity for school policies, which are my parameters of interest.

A useful component of 2SRI is that this method allows for a direct test of policy endogeneity. If the predicted residuals, $\hat{v}_s$, are jointly significant in the second stage behavior regression, then this indicates the presence of endogeneity. Importantly, I did not find evidence of policy endogeneity across any of the models estimated in this chapter.

The first stage results provide a test of the validity of the instruments. In order to test for weak instruments, I ran the first stage regression for each policy variable and then tested the joint significance of the instruments for each regression. The first-stage results are presented in Table 4.2 below. The general bar for rejecting an instrument as weak is a first stage partial F-statistic that is less than 30. The partial F-statistics for the first stage of the models all indicated that the instruments passed the test for weak instruments. More specifically, the partial F-statistic for the first-stage daycare regression was 77.47. The partial F-statistic for separate schooling was 93.48, and the partial F-statistic for family planning services was 55.29. Given that the first-stage results indicated that the instruments were viable, we can move on to the second stage regressions that test for the presence of policy endogeneity.

The second stage results provide a direct test of policy endogeneity, and these results indicated that endogeneity was not an issue. Given this, the models assuming exogeneity are my preferred models, so I will discuss the second stage test for endogeneity but will not present the results in a table. In order to check for endogeneity, I tested the joint significance of the predicted residuals, generated from the first-stage regressions, in each of the second stage regressions. Overall, the predicted residuals were not jointly significant in the second stage behavior regressions. While the predicted residuals were jointly significant for the "any sex" regression ($p<0.05$), two of three predicted residuals were only significant at the $p<0.10$ level. Given the marginal significance of these residuals and the lack of evidence of policy endogeneity

for all of the remaining behavior regressions, endogeneity did not appear to be a concern for the "any sex" regression. The predicted residuals were not jointly significant for the school year sex frequency ($p=0.63$) or the "any birth control" ($p=0.70$) second stage regressions. Finally, the predicted residuals for the second stage multinomial logit regression for sexual strategies were jointly significant ($p<0.05$). However, of the 18 predicted residuals included in the regression (three for each of the six outcomes), only two were individually statistically significant. This general lack of statistical significance of the predicted residuals does not provide enough evidence to indicate the presence of policy endogeneity. Given these findings, my preferred specifications for this chapter are those assuming policy exogeneity. Thus, I will focus on interpreting results from the models assuming policy exogeneity in the results section.

RESULTS

Again, I will discuss the results for the models assuming policy exogeneity given I failed to reject exogeneity using 2SRI. I presented the results as the marginal effects of the variables from the various non-linear models (the only linear model being school year sex frequency) rather than their coefficients since coefficients can be misleading in probit and multinomial logit models. Marginal effects are interpreted as the change in the probability of an outcome given a one-unit increase in the variable of interest. It is important to note that the tables will indicate two different numbers of observations: one for the full sample that Stata needed to use to control for the survey design (to make the sample representative) and one for the subpopulation observations across which the actual coefficients and marginal effects are to be estimated. The discrepancies between the observation counts are due to missing values on the dependent variables of interest.

Sexual Behaviors Results

The results from the "any sex", sex frequency, and "any birth control" regressions are shown in Table 4.3 below. The marginal effects for the probability of any sexual activity in the school year are presented in the first column of Table 4.3. None of the policy variables mattered with respect to any sexual activity. Thus, these policies do not seem to push students into or deter students from sexual activity. Older students, students without a father present, and those who attend larger schools were more likely to be sexually active while students who were immigrants, were more religious, perceived themselves to be overweight, and whose mothers graduated college (relative to some college) were less likely to be sexually active.

The coefficients for the OLS regression of school year sex frequency conditional on sexual activity are reported in column two of Table 4.3. These results indicate that offering family planning services (either on campus or at another school in the district) increased school year sex frequency by +11.5 ($p<0.10$) events. Sexual frequency was not affected by school-linked daycare or separate schooling policy. African American students reported lower sexual frequency as did students in larger schools. Students with higher household income had higher school year sex frequencies.

Like the "any sex" outcome, none of the policy variables mattered with respect to "any birth control use" conditional on sexual activity. Older students, students with no father present, and those from larger schools were more likely to report some birth control use. Students attending school in an urban setting were less likely to use at least some birth control conditional on sexual activity.

Sexual Strategies Results

The marginal effects from the multinomial logit model of sexual strategies assuming policy exogeneity are presented in Table 4.4 below. In this case, the marginal effects represent the probability of being in each respective category. In order to discuss these results, I will focus on one policy variable at a time.

Students in school that provided daycare were +1.8 percent ($p<0.01$) more likely to be in the low sex and some birth control group. Recall that the low group included 1 - 3.14 sexual encounters in the school year and that birth control use indicated that they at least used birth control once.

Providing family planning services on-campus or at another school in the district was not associated with a student being in the no sex / no birth control group or either of the low sex frequency groups. However, students attending schools that offered family planning services were -6.2 percent ($p<0.01$) less likely to be in the medium sex frequency / no birth control group. Recall that the medium sex frequency group ranged from 3.15 to 28.52 encounters during the school year. Students in schools that offered family planning services were also more likely to choose medium frequency / some birth control (+3.5 percent; $p<0.05$) and high frequency some birth control (+3.8 percent; $p<0.01$).

Requiring a student to attend a separate school (including home schooling) was not associated with the probability of being in any of the sexual strategy groups.

With regard to other interesting relationships in this model, older students were more likely to be in the medium and high sex frequency categories (regardless of birth control use), but the effect sizes were larger for the categories including some birth control use. Older students were also less likely to not be sexually active (no sex / no birth control category), and

more likely to be in the low frequency / some birth control group. Latino students were more likely to be in the no sex / no birth control group and less likely to be in the low frequency / some birth control and high frequency some birth control groups (the reference group was white students). African American students had a higher probability of being in the medium frequency / some birth control group and a lower probability of being in the high frequency / some birth control group. Immigrants were more likely to choose the no sex / no birth control option. Students with no father present had a lower probability of being in the no sex / no birth control group but a higher probability of being in the high frequency / some birth control category. More religious students were also more likely to choose the no sex / no birth control option and were also less likely to choose low frequency / some birth control or either of the medium frequency options. Students who perceived themselves to be overweight had a higher probability of choosing the no sex / no birth control option as well as the medium frequency / some birth control option.

DISCUSSION

These results indicated that school policies related to reproductive health did seem to matter with regard to student sexual decision making. In the models focusing on the individual components of pregnancy risk (any sex, frequency, and birth control use), school policies did not matter with regard to having any sex or conditional birth control use. For the having any sex option, this may be because the decision to initiate sexual activity is so important that it is unlikely to be affected by offering daycare, family planning services, or requiring pregnant students to attend separate schools. Conditional birth control use was also not affected by these policies as well.

In the multinomial logit model predicting sexual strategy choice, daycare increased the probability that a student chose the low sex / some birth control option. Although I did not find evidence of daycare affecting sexual activity, frequency, or birth control use separately, it seems that when this decision was modeled as a joint choice, daycare did have a statistically significant effect. Breaking up frequency and birth control use into these categories allowed for a finer analysis of decision-making and ultimately more closely follows actual decisions about sexual activity, since frequency and contraceptive decisions are made simultaneously. This result for daycare from the multinomial logit model suggests that daycare may have had an effect of increasing the probability that students initiate sex or engage in low frequencies of sex with some birth control use. One possible explanation for this finding is that daycare lowers the cost of sexual activity by decreasing the negative consequences of being a teenage parent in such a way that students are more likely to engage in low amounts of sexual activity. These findings provide some evidence that daycare may have spillover effects to students who are not the intended targets of the policy; however, the effect size was relatively small, and the students were in a relatively low-risk group for pregnancy, with low frequency (1-3.15 encounters) and contraception use during at least one of these encounters. Thus, the potential spillover effects of providing school-linked daycares appear to be relatively minimal.

With regard to family planning services, conditional on being sexually active, this policy was associated with higher school year sexual frequency. This may be because offering family planning services decreases the cost of sexual activity for students, either by making contraception more easily accessible or by destigmatizing sexual activity in the school setting. Although family planning services were associated with increased sexual frequency, this policy did not affect birth control use. Upon further analysis in the multinomial logit models, it

appeared that this may have been due to the joint nature of the frequency and birth control use decisions. In the multinomial logit regressions, for example, family planning services did not affect low frequency birth control use. These students who fall into the low frequency category may have been muting the effect of family planning services on birth control use for the any birth control model. Family planning services decreased the likelihood of medium frequency / no birth control but increased the likelihood of medium and high frequency with at least some birth control. These results suggest that students in schools with family planning services have higher sex frequencies, but they are also more likely to use at least some birth control. Both of these effects can be explained as a reaction to the reduction in cost of both sexual activity and birth control due to family planning services being offered at the school level.

The policy implications of these findings are that offering family planning services might have unintended consequences on student sexual behaviors that actually put them at higher risk for pregnancy. Since family planning services were associated with increased school year sexual frequency (OLS regression) and higher probabilities of being in the medium and high frequency groups with some birth control, these policies likely put students at higher risk for pregnancy. Although the students who attend schools with family planning services were more likely to be in the medium or high frequencies groups *with* birth control, recall that this measure incorporates any birth control use. This means that a student could be in the high frequency group (more than 28.52 encounters) and have only used birth control at one of these encounters. Of course this would be the worst-case scenario with regard to pregnancy risk, but it is important to point out that "any birth control" use does not mean that students are consistently using contraceptives. Thus, being in the medium and high frequency groups even with some birth control use could increase pregnancy risk for these students. Additionally, even if the birth control measure

captured only students who always used birth control, just having higher frequency would increase their pregnancy risk due to the potential contraceptive failure. My findings suggest that offering family planning services was associated with increased pregnancy risk for never-pregnant students. However, it is important to point out that a small proportion of schools (3.9 percent) provided family planning services, so these findings could also be an artifact of the small variation in family planning service policy – though not in a way that is generating endogeneity bias due to unobservables or reverse causality in the data.

Requiring separate schooling for pregnant students did not affect student decisions about sexual behaviors in any of the models. It may be that this type of policy is not as salient to students. Although it is punitive in nature, unlike daycare, this policy removes parenting students from school, which may in turn make the policy less visible to students. Additionally, family planning services affects non-parenting students as well (which was the sample I used in this analysis), which could explain the impact of family planning services relative to the lack of impact of separate schooling, which only affects pregnant students.

Table 4.1: Variable Means and Standard Deviations
All Add Health Wave 1 never-pregnant females.
Means not weighted.

	Mean	Std. Deviation
Sexually active	0.256	0.437
Conditional birth control use	0.823	0.382
Conditional school year frequency	39.33	50.97
Daycare indicator	0.170	0.376
Family planning service indicator	0.0372	0.189
Separate school indicator	0.279	0.449
Age	15.36	1.670
Hispanic	0.148	0.355
White	0.548	0.498
Black	0.221	0.415
Other race	0.0830	0.276
Household income ($1,000)	47.69	56.20
Immigrant	0.0748	0.263
School size (1-3)	2.292	0.719
Urban	0.291	0.454
Suburban	0.523	0.500
Rural	0.186	0.389
West	0.215	0.411
Midwest	0.250	0.433
Northeast	0.161	0.367
South	0.375	0.484
Mom-college graduate	0.287	0.453
Mom-HS graduate/GED	0.340	0.474
Mom-some college	0.223	0.416
Mom-less than high school graduate	0.150	0.357
No father present	0.425	0.494
Welfare	0.0808	0.272
Religiosity (1-4)	1.827	1.176
Self-perceived overweight	0.396	0.489
Instruments		
Family planning clients 20-44 per women 20-44	0.0899	0.0545
Proportion conservative religion	0.166	0.144
Proportion voting Republican, 1992	0.383	0.0882
Proportion local gov't expenditures for education	0.455	0.135
Observations	4842	

Table 4.2: First Stage Results-2SRI
Estimated on Wave 1, female, never pregnant, in-home sample
* p<0.10, ** p<0.05, *** p<0.01

	(1) Daycare b/t	(2) Family Planning Counseling b/t	(3) Separate School b/t
Age	-0.0050	0.0058***	-0.029***
	(-1.53)	(3.55)	(-8.14)
Hispanic	-0.029	0.030***	0.039**
	(-1.59)	(3.31)	(1.98)
African American	0.043***	-0.032***	-0.018
	(3.04)	(-4.49)	(-1.15)
Other race	-0.025	-0.013	-0.075***
	(-1.18)	(-1.22)	(-3.18)
Household income	-0.000075	-0.000065	-0.00013
	(-0.78)	(-1.35)	(-1.26)
Immigrant	-0.055**	-0.011	0.032
	(-2.52)	(-1.00)	(1.34)
School size	0.037***	0.0078*	-0.12***
	(4.44)	(1.85)	(-13.36)
Urban	0.068***	-0.0088	0.33***
	(4.02)	(-1.04)	(17.97)
Suburban	-0.14***	-0.050***	0.10***
	(-8.93)	(-6.52)	(6.22)
West	0.018	-0.033***	-0.17***
	(0.96)	(-3.63)	(-8.36)
Midwest	-0.080***	-0.011	-0.39***
	(-4.74)	(-1.25)	(-21.02)
Northeast	0.10***	0.14***	-0.39***
	(5.11)	(14.21)	(-17.29)
Mother -college graduate	-0.021	-0.014*	0.0016
	(-1.41)	(-1.84)	(0.10)
Mother -HS graduate/GED	0.019	0.0047	0.0067

	(1.38)	(0.68)	(0.44)
Mother-no HS diploma	-0.020	0.0060	0.015
	(-1.12)	(0.68)	(0.77)
No father present	0.015	0.0087	0.0078
	(1.33)	(1.60)	(0.65)
Welfare	0.015	0.035***	-0.053**
	(0.76)	(3.54)	(-2.44)
Religiosity	0.0017	-0.0022	-0.019***
	(0.37)	(-0.96)	(-3.83)
Self-perceived overweight	-0.0011	0.00056	0.017
	(-0.10)	(0.11)	(1.51)
Family planning clients 20-44 per women 20-44 county	0.76***	0.11**	-0.92***
	(6.89)	(2.05)	(-7.59)
Proportion conservative religion county	0.071	0.20***	-0.75***
	(1.34)	(7.70)	(-12.84)
Proportion voting Republican, 1992	-0.92***	-0.28***	-0.41***
	(-13.07)	(-7.82)	(-5.32)
Proportion local gov't expenditures for education	0.12***	-0.21***	-0.35***
	(2.66)	(-9.15)	(-6.91)
Constant	0.43***	0.11***	1.61***
	(6.08)	(3.07)	(20.90)
Observations		4828	

Table 4.3: Marginal Effects for Sexual Behaviors-Exogenous Policies
Estimated on Wave 1, female, never pregnant, in-home sample
* p<0.10, ** p<0.05, *** p<0.01

	(1) Any Sex (Probit)	(2) Conditional Frequency (OLS)	(3) Conditional Birth Control Use (Probit)
Daycare	0.021	-5.51	-0.016
	(1.24)	(-1.24)	(-0.45)
Family planning services	0.057	11.5*	-0.0070
	(1.31)	(1.83)	(-0.11)
Enrolled in a separate school	-0.012	-3.44	0.030
	(-0.61)	(-0.72)	(1.17)
Age	0.078***	1.93	0.041***
	(16.36)	(1.17)	(4.72)
Hispanic	-0.11***	-4.56	-0.057
	(-3.41)	(-0.51)	(-1.33)
African American	0.013	-15.0***	-0.0067
	(0.62)	(-2.72)	(-0.17)
Other race	-0.011	3.21	-0.030
	(-0.33)	(0.32)	(-0.50)
Household income	-0.000036	0.13***	0.00056
	(-0.22)	(2.92)	(1.49)
Immigrant	-0.10**	-6.51	0.011
	(-2.41)	(-0.76)	(0.17)
School size	0.029**	-7.30*	0.040**
	(2.45)	(-1.93)	(2.28)
Urban	0.023	-7.25	-0.075*
	(0.90)	(-1.18)	(-1.93)
Suburban	0.014	-6.67	-0.016
	(0.74)	(-1.28)	(-0.45)
West	-0.072***	11.3	-0.0099
	(-2.59)	(1.65)	(-0.23)

Midwest	-0.054***	1.33	0.014
	(-2.70)	(0.24)	(0.41)
Northeast	-0.053**	3.37	0.025
	(-2.30)	(0.58)	(0.68)
Mother -college graduate	-0.060***	-1.23	-0.013
	(-3.26)	(-0.18)	(-0.29)
Mother -HS graduate/GED	-0.0098	6.63	0.024
	(-0.57)	(1.28)	(0.69)
Mother-no HS diploma	0.018	-0.91	-0.017
	(0.75)	(-0.17)	(-0.41)
No father present	0.065***	4.26	0.060**
	(3.94)	(0.78)	(2.18)
Welfare	0.015	7.99	-0.039
	(0.53)	(0.73)	(-1.01)
Religiosity	-0.040***	3.18	-0.013
	(-6.37)	(1.33)	(-1.10)
Self-perceived overweight	-0.043***	-1.86	-0.015
	(-2.67)	(-0.40)	(-0.67)
Constant		17.8	
		(0.62)	
Total Observations	9932	9589	9932
Subpopulation Observations	4842	898	1241

Table 4.4: Marginal Effects from Multinomial Logit for Sexual Strategies-Exogenous Policies
Estimated on Wave 1, female, never pregnant, in-home sample. Reference group is no sex/no birth control
* p<0.10, ** p<0.05, *** p<0.01

	(0) No Sex & No BC b/t	(1) Low Sex & No BC b/t	(2) Low Sex & BC b/t	(3) Medium Sex & No BC b/t	(4) Medium Sex & BC b/t	(5) High Sex & No BC	(6) High Sex & BC
Daycare	-0.019	0.0052	0.018***	-0.0019	-0.014	-0.0017	0.013
	(-1.27)	(1.31)	(3.20)	(-0.59)	(-1.06)	(-0.39)	(1.39)
FP services	0.0017	0.0031	-0.014	-0.062***	0.035**	-0.0017	0.038***
	(0.04)	(0.50)	(-0.97)	(-2.85)	(2.15)	(-0.25)	(2.60)
Separate school	0.021	-0.0039	-0.0045	-0.0013	0.0059	-0.0060	-0.012
	(1.14)	(-0.89)	(-0.55)	(-0.52)	(0.53)	(-1.49)	(-1.13)
Age	-0.057***	-0.000031	0.0061***	0.0013**	0.025***	0.0028***	0.022***
	(-13.75)	(-0.04)	(3.09)	(2.48)	(8.14)	(3.06)	(10.01)
Hispanic	0.094***	0.0011	-0.023*	-0.00097	-0.028	-0.0013	-0.042**
	(2.98)	(0.19)	(-1.77)	(-0.27)	(-1.33)	(-0.26)	(-2.32)
African American	0.0065	0.0034	0.0019	-0.00074	0.023**	-0.0015	-0.033***
	(0.38)	(0.79)	(0.23)	(-0.24)	(2.28)	(-0.32)	(-3.33)
Other race	0.088**	-0.026**	-0.0030	-0.060***	-0.0093	0.0076	0.0025
	(2.01)	(-2.12)	(-0.19)	(-2.81)	(-0.34)	(1.27)	(0.15)
Household income	0.00044**	-0.000020	-0.00039**	-0.0000057	-0.00012	-0.000073	0.00017***
	(2.07)	(-0.28)	(-2.04)	(-0.39)	(-0.85)	(-1.03)	(4.87)
Immigrant	0.17***	-0.018	0.011	-0.058***	-0.053	-0.028***	-0.023
	(3.37)	(-1.63)	(0.85)	(-2.86)	(-1.43)	(-2.71)	(-0.90)
School size	-0.021*	0.0021	0.011*	0.000037	0.0090	-0.0016	0.0011
	(-1.75)	(0.66)	(1.89)	(0.03)	(1.30)	(-0.53)	(0.21)
Urban	-0.036	0.0049	0.014	-0.00021	0.023	0.0039	-0.010
	(-1.33)	(1.17)	(1.20)	(-0.06)	(1.29)	(0.74)	(-0.89)
Suburban	-0.028	0.0038	0.0091	0.0023	0.020	-0.0042	-0.0028
	(-1.24)	(0.85)	(0.94)	(0.67)	(1.33)	(-0.73)	(-0.38)
West	0.063**	-0.026***	-0.025**	-0.00027	-0.0027	-0.0067	-0.0025
	(2.53)	(-2.96)	(-2.37)	(-0.09)	(-0.20)	(-1.11)	(-0.23)

Midwest	0.041**	-0.0016	-0.0065	0.00037	-0.0061	-0.0097	-0.018**
	(2.07)	(-0.33)	(-0.87)	(0.16)	(-0.44)	(-1.36)	(-2.24)
Northeast	0.064***	-0.012**	-0.0081	0.00086	-0.025	-0.00013	-0.019
	(2.61)	(-1.97)	(-0.70)	(0.29)	(-1.33)	(-0.03)	(-1.48)
Mother –coll grad	0.021	-0.0027	0.013	0.00083	-0.013	-0.0031	-0.016
	(1.35)	(-0.47)	(1.50)	(0.27)	(-0.98)	(-0.50)	(-1.51)
Mother –HSG/GED	0.00061	-0.0021	0.014	-0.0027	-0.012	0.0044	-0.0019
	(0.04)	(-0.39)	(1.60)	(-0.91)	(-1.08)	(0.94)	(-0.18)
Mother-no HSG	0.0018	0.0042	0.0011	-0.0031	0.00050	0.0040	-0.0085
	(0.08)	(0.50)	(0.09)	(-0.80)	(0.03)	(0.71)	(-0.80)
No father present	-0.035**	-0.0017	-0.0031	0.00029	0.0096	0.0033	0.026***
	(-2.26)	(-0.49)	(-0.41)	(0.12)	(0.89)	(0.73)	(3.10)
Welfare	-0.015	0.00022	-0.016	0.00069	0.012	0.0013	0.017
	(-0.56)	(0.03)	(-1.24)	(0.22)	(0.75)	(0.24)	(0.85)
Religiosity	0.025***	-0.00096	-0.0081**	-0.0019*	-0.011**	-0.00012	-0.0031
	(4.00)	(-0.76)	(-2.57)	(-1.69)	(-2.28)	(-0.08)	(-0.97)
Self-perceived	0.041***	-0.0013	-0.0093	0.0020	-0.021**	-0.0029	-0.0082
overweight	(2.63)	(-0.30)	(-1.32)	(0.88)	(-2.25)	(-0.75)	(-1.16)
Observations				9589			
Subpopulation				4499			

CHAPTER 5

EXPLORING MECHANISMS BETWEEN POLICIES AND RISK

INTRODUCTION

Recall from Chapter 3, I identified multiple parameters that might be linked to student pregnancy risk and the resulting behaviors determining pregnancy risk. Three of these parameters were: 1) income/human capital expectations; 2) the psychological cost of sex as a teenager; and 3) the disutility of teenage pregnancy. In the theoretical model, I showed how changes in these parameters can influence sexual behaviors of students that put them at increased risk for teenage pregnancy. In the previous chapter, I explored how school policies related to student reproductive health might be related to students' decisions about sexual behaviors, but this chapter is focused on how the policies might drive certain parameters of the theoretical model and is not focused on student behavioral choices.

In addition to learning how school policies affected the sexual decision-making of students (Chapter 4), it would also be interesting and beneficial to understand the potential pathways by which these policies had an impact on student sexual behaviors that put them at risk for teenage pregnancy. The Add Health study includes variables that allow a test of how factors, including school policies, affect the parameters in my model from Chapter 3. Each of these parameters may be affected by school policies related to student reproductive health in a way that might ultimately affect sexual behaviors. Changes to these parameters could act as potential mechanisms for how school policies modify students' sexual behaviors. Thus, the focus of this

analysis is to examine how providing school-linked daycare, family planning services, and requiring pregnant students to attend a separate school affected these parameters.

The first set of mechanisms I focused on for this chapter was those related to income/human capital. In the theoretical model, I identified second period income and the expected income penalty from pregnancy as a teenager as two parameters that could affect sexual behaviors. The former was represented by the parameter, w, in my theory presented in Chapter 3, while the latter was reflected in the parameter, δ. In the Add Health data, there are three empirical analogs for these parameters: 1) the student's expectation about whether she will graduate college; 2) her expectation about whether she will have a middle class family income by age 30; and 3) her belief about whether she would have to quit school if she became pregnant. I will provide more detail on the question wording later. Given that daycare would ameliorate the potential detrimental effects of teenage pregnancy on human capital accumulation by allowing the student to remain in school, she may be more likely to think that she will graduate college, have a middle class income by age 30, or be less likely to believe that she would have to quit school if she became pregnant if her school adopts this policy. Family planning services might also increase expectations for the future and decrease the likelihood that she believes she would have to quit school because access to contraceptives might strengthen her belief that she will not become pregnant. Separate schooling for pregnant students could decrease expectations for the future if she believes she it at high risk for pregnancy. Additionally, if students view this policy as punitive and not as a service to pregnant students, they are probably more likely to believe that they would have to quit school if they became pregnant.

The second type of mechanism I identified was associated with the psychological cost of sex parameter (h) from the theoretical model. Add Health respondents were asked about their

motivations to engage in risky behaviors, and one of the questions asked them to report if they would feel guilty after sex. If having a daycare or family planning services normalizes sexual activity in the school, then these policies may be associated with a lower probability that a student reports that she would feel guilty after sex. Conversely, a punitive policy, such as requiring pregnant students to attend separate schools, might increase guilt associated with sexual activity.

Finally, I found variables in the data that coincided with the parameter in the theoretical model focusing on the disutility associated with pregnancy as a teenager (θ). The students were asked if pregnancy would be the worst thing that could happen to them, if pregnancy would not be that bad, if it would embarrass their families, and if it would embarrass them personally. Each of these captures some form of disutility associated with pregnancy as a teenager. If daycare reduces the cost of becoming pregnant as a teenager, then students might be less likely to report that pregnancy is the worst thing that could happen to them and more likely to report that it would not be that bad. As above, if providing daycare or family planning services at the school normalizes sexual activity or teenage pregnancy, then these policies might be associated with less embarrassment. Requiring pregnant students to attend separate schools would likely increase the cost of becoming pregnant as a teenager, which might lead to more negative feelings about becoming pregnant as a teenager or create stigma and therefore increase embarrassment.

DATA

Description

The details of the Add Health data are discussed in Chapter 4 above. I used the same data for the analysis in this chapter and the same strategy to account for the complex sampling design, which was also discussed in Chapter 4.

Creating Outcome Variables

For this analysis, I was interested in identifying measurable corollaries in the data to parameters in my theoretical model. Broadly, there are three sets of mechanisms that could link the school policies of interest to student sexual behaviors. These include: 1) income/human capital expectations; 2) psychological costs of sex as a teenager; and 3) disutility from teenage pregnancy. There are multiple empirical analogues to these parameters in the data. All of these outcomes were originally ordered likert-type outcomes. I wanted to measure the effect of these policies on the probability that students felt strongly about these expectations or attitudinal variables. Additionally, all but two of the variables (middle class income expectation and guilt with sex) were clustered around either strong agreement or strong disagreement with the statements. For these reasons, I dichotomized each outcome based on whether the student expressed agreement or strong agreement with each statement. For the expectations outcomes, this meant the student agreed that the outcome was at least pretty likely. For the other attitudinal variables, this meant that the student at least agreed with the statement. More details about the question wording and response choices are provided below.

Outcome 1: Income/Human Capital Expectations Outcome Variables

First, I identified several variables related to income expectations that could operate as mechanisms between school policies and student sexual behaviors. In Wave 1, respondents were asked how likely it was that they would graduate from college, have a middle class income by the time they are 30 years of age, and have to quit school if they become pregnant. These variables are inherently ordered in the data (that is, lower category responses to each question correspond to lower levels of an unobservable latent variable of the subjective probability of the event occurring). The questions about college graduation and middle class income expectations were pulled from the in school questionnaire; however, I still limited the sample to those students selected for the in-home survey. The college and income expectations measures range from "no chance" to "it will happen" on a nine-point likert-type scale. The exact question wording was:

- *On a scale from "No chance" to "It will happen" what do you think are the chances you will graduate from college?*
- *On a scale from "No chance" to "It will happen" what do you think are the chances you will have a middle-class family income by age 30?*

The response options included:

1. *no chance*
2. *1*
3. *some chance*
4. *3*
5. *about 50-50*
6. *5*
7. *pretty likely*

8. *7*

9. *it will happen*

I dichotomized these responses as a one if the respondent indicated that it was at least "pretty likely" that this would happen (7-9 on the scale) and a zero otherwise. Descriptive statistics are reported in Table 5.1 below. As of Wave 1, 86.2 percent of respondents reported that they expected to be at least "pretty likely" to graduate college. Additionally, 57.9 percent indicated that they expected to be at least "pretty likely" to have a middle-class family income by age 30.

The respondents were also asked how likely it would be that they would have to quit school if they became pregnant. The quit school variable ranged from strongly agree to strongly disagree on a five-point likert-type scale. The question wording for this variable was:

> *"The next questions are about how you would feel about having sexual intercourse at this time in your life. Some people have sexual intercourse before they get married. Others do not. For these questions, it doesn't matter whether you yourself have had intercourse. Just indicate whether you agree or disagree with the statements."*

- *If you got pregnant, you would have to quit school*.

The available responses were:

1. *Strongly agree*

2. *Agree*

3. *Neither agree nor disagree*

4. *Disagree*

5. *Strongly disagree*

I created an indicator variable that equals one if the respondent said that she agreed or strongly agreed with the statement and was zero otherwise. For this outcome, 19.9 percent of respondents reported that they at least agreed that they would have to quit school if they became pregnant.

Outcome 2: Psychological Cost of Sex as a Teenager Outcome Variable

Another potential mechanism between school policies and sexual behaviors in the theoretical model is the psychological cost of sex as a teenager. I identified one empirical analogue in the data. All students were asked about motivations to engage in risky behaviors, and one of the questions asked if they would feel guilty if they were sexually active. The responses ranged on a five-point likert-type scale from strongly agree to strongly disagree. The question wording for this variable was:

> *"The next questions are about how you would feel about having sexual intercourse at this time in your life. Some people have sexual intercourse before they get married. Others do not. For these questions, it doesn't matter whether you yourself have had intercourse. Just indicate whether you agree or disagree with the statements."*

- *If you had sexual intercourse, afterward, you would feel guilty.*

The available responses were:

1. *Strongly agree*
2. *Agree*
3. *Neither agree nor disagree*
4. *Disagree*
5. *Strongly disagree*

I created an indicator variable that equaled one if the respondent reported that she agreed or strongly agreed with the statement and zero otherwise. Almost 50 percent reported that they at least agreed that sex would make them feel guilty.

Outcome 3: Expected Disutility Associated with Teenage Pregnancy Outcome Variables

The final potential mechanism I identified from the theoretical model was the disutility associated with teenage pregnancy. The respondents were asked about how they would feel if they became pregnant at that time in their lives. More specifically they were asked how strongly they agreed that getting pregnant at that time would be the worst thing that could happen to them. They were also asked how strongly they agreed with the statement that getting pregnant at that time would not be all that bad. Both of these questions ranged from strongly agree to strongly disagree on a five-point likert-type scale. I dichotomized these responses into a variable that equaled one if the respondent agreed or strongly agreed and zero otherwise. 6.3 percent reported that a teenage pregnancy would not be that bad as of Wave 1, and 87.1 percent reported that pregnancy would be the worst thing that could happen to them at that time. Respondents were asked two questions about how strongly they agreed that becoming pregnant at the current time would have been either embarrassing for them or embarrassing for their families. The responses ranged on a five-point likert-type scale from strongly agree to strongly disagree. I created an indicator variable that was equal to one if they said they either agreed or strongly agreed with the statement and a zero otherwise. About 65 percent of students indicated that becoming pregnant as a teenager would embarrass their family, and almost 70 percent said this would be personally embarassing. The question wording for these variables was:

"The next questions are about how you would feel about having sexual intercourse at this time in your life. Some people have sexual intercourse before they get married. Others do not. For these questions, it doesn't matter whether you yourself have had intercourse. Just indicate whether you agree or disagree with the statements."

- *Getting pregnant at this time in your life is one of the worst things that could happen to you.*
- *It wouldn't be all that bad if you got pregnant at this time in your life.*
- *If you got pregnant, it would be embarrassing for you.*
- *If you got pregnant, it would be embarrassing for your family.*

The available responses were:

1. *Strongly agree*
2. *Agree*
3. *Neither agree nor disagree*
4. *Disagree*
5. *Strongly disagree*

Independent School Policy Variables

The independent variables are the same as from Chapter 4. A brief description of the policy variables of interest and control variables is below. Refer to Chapter 4 for a more detailed discussion

The independent variables of interest for this analysis were a set of school policies related to student reproductive health including: 1) school-linked daycare; 2) school-linked family planning services; and 3) requiring a pregnant student to attend a separate school (or home schooling). Each of these policies presumably could affect pregnancy risk either by altering the

cost of teenage pregnancy directly or indirectly by changing the cost of behaviors that lead to pregnancy. These policies could also affect student expectations for the future and sex/pregnancy attitudes in the same way.

The information to create these policy variables came from the Wave 1 Administrator survey. An administrator from each school participating in the study responded to a survey that asked about school characteristics, including detailed information regarding school policies. For the daycare and family planning service questions, the administrators were asked if the school provided each of these and in what capacity. More specifically, the administrator chose between four options: 1) provided on school premises; 2) provided by the district (at another school); 3) referred to other providers; and 4) neither provided nor referred. I used this information to create a dichotomous indicator variable for whether or not the school offered either of these services to students. The daycare and family planning services variables are equal to 1 if either the school or district provided the service and equal to 0 otherwise. The separate schooling variable is also a dichotomous indicator variable where a 1 indicates that pregnant students were required to attend separate schools (including home schooling) and a zero if this requirement was not in place. Since the summary statistics in Table 1 are at the individual level, I also calculated descriptive statistics separately at the school level. Out of 127 schools in the sample, 15.7 percent had a school-linked daycare, 3.9 percent provided family planning services, and 33.9 percent required separate schooling for pregnant students.

Control Variables

Since sexual behaviors are complex, I included control variables at the individual, family, and community level. I controlled for demographic, socioeconomic, cultural, and community

characteristics including; age, race/ethnicity income, immigrant status, parent's education, family structure, welfare receipt, religiosity, self-perceived overweight status, school size, urbanicity, and region. Details of each variable can be found in Appendix A.

RESULTS

I focused on three potential mechanisms linking policies to student sexual behaviors including: 1) income/human capital expectations; 2) psychological cost of sex as a teenager; and 3) perceived costs of teenage pregnancy. For the human capital expectations I examined three outcome variables: 1) expectation for college graduation; 2) expectation for a middle class income by age 30; and) how strongly the respondent believes she would have to quit school if she became pregnant.

I ran two sets of models: one assuming policy exogeneity and another assuming policy endogeneity. For the models assuming policy exogeneity I used probit regressions since I defined each outcome as dichotomous. Because the behavioral outcome was non-linear, I used two-stage residual inclusion (2SRI) as the instrumental variables approach to deal with the potential policy endogeneity. Refer to Chapter 4 for a more detailed discussion of this method. Recall that this method provides a direct test of policy endogeneity. As in Chapter 4, I did not find evidence of endogeneity with regard to the policy variables of interest. Given that the first stage regression was identical in Chapter 4 (Table 4.1), I will not show the table in this chapter, but recall that the instruments passed the test for weak instruments.

In order to determine if endogeneity was a problem, I tested the joint significance of the predicted residuals in each of the second stage regressions. Generally the predicted residuals were not jointly statistically significant in any of the models, which indicates that policy

endogeneity was not a concern for this analysis. The three second-stage models that did have jointly statistically significant residuals were either marginally significant (guilt: joint significance p=0.0955), the residuals were jointly significant but none were individually significant in the model (pregnancy would embarrass family: joint significance p=0.0585), or only one predicted residual was significant at the p<0.05 level and another was marginally statistically significant at p=0.096 (pregnancy is the worst: joint significance p=0.0683). Given that the majority of evidence in both Chapter 4 and Chapter 5 points to a lack of policy endogeneity, the preferred specifications are those assuming policy exogeneity and I will only discuss the results from those models.

I presented the results as the marginal effects of the variables from the various models, rather than their coefficients (since coefficients can be misleading in probit models). Marginal effects are interpreted as the change in the probability of a positive outcome given a one-unit increase in the variable of interest.

Results for Human Capital / Income Expectations:

The results for the set of outcome variables focused on expectations related to human capital and income are presented in Table 5.2 below. Students in schools that offered family planning services were -5.2 percent (p<0.05) less likely to report that they expect to graduate from college than female students in schools without family planning services. None of the school policies were predictive of future income expectations. Offering family planning services decreased the likelihood that a student reported she would have to quit school if she became pregnant by -7.7 percent (p<0.10). Respondents in schools that required pregnant students to

attend separate schools were +8.4 percent ($p<0.01$) more likely to believe that they would have to quit school if they became pregnant.

Interestingly, I found essentially no differences by race for the college and income expectations outcome variables. However, African American students were less likely to report they would have to quit school if they became pregnant. Additionally, mother's education mattered with regard to each expectation outcome. More specifically, a mother with a college degree increased the likelihood that a student thought she would graduate college. However, having a mother with a high school degree or less was predictive of a decreased probability of a student reporting that she believed she would attend college. A mother having a college degree was predictive of an increased likelihood that a student reported she would have a middle class income by the time she was 30 years of age. Having a mother with a college degree increased the probability that a student agreed with the statement that she would have to quit school if she became pregnant. Finally, increased religiosity was predictive that the students had higher expectations of college attendance, higher income expectations, and higher expectations that she would have to quit school in the event of a teenage pregnancy.

Results for Psychological Costs of Sex as a Teenager:

The results for the psychological costs models (guilt with sexual activity) are reported in Table 5.3. With regard to the psychological costs of sexual activity as a teenager, family planning services was the only policy variable that had an effect. Students in schools that offered family planning services were -8.7 percent less likely ($p<0.10$) to report that having sex would make them feel guilty. Older students, African American students, students with no father present, and students who attended larger schools were less likely to report that they would feel

guilty with sexual activity. More religious students and students who were immigrants were more likely to report that they would feel guilty after sex.

Results for Expected Disutility of Teenage Pregnancy:

Finally, the results for the perceived disutility associated with teenage pregnancy are shown in Table 5.4 below. I modeled four different measures of the disutility associated with teenage pregnancy including: 1) the belief that pregnancy would not be that bad; 2) the belief that pregnancy would be the worst thing that could happen; 3) the belief that pregnancy would embarrass the student's family; and 4) the belief that pregnancy would embarrass the student. None of the school policies were predictive of a student reporting that either pregnancy would not be that bad or that pregnancy would be the worst thing that could happen to her at the current time. However family planning services did matter for the questions about teenage pregnancy being embarrassing. Students with school-linked family planning services were -5.4 percent ($p<0.10$) less likely to report that becoming pregnant at the time of the survey would embarrass family and were also -8.5 percent ($p<0.01$) less likely to report that pregnancy would be personally embarrassing. Older and African American students were less likely to report expected disutility with pregnant regardless of outcome, and students with no father present were less likely to indicate that pregnancy would be personally embarrassing or embarrassing for their families.

DISCUSSION

The results from this chapter indicated that school policies can intervene on student attitudes and behaviors that have been linked to behaviors that determine pregnancy risk.

Daycare was not associated with a change in expectations or sex/pregnancy attitudes. The most consistent findings were related to family planning services seeming to destigmatize sexual activity or teenage pregnancy. Family planning services decreased expected embarrassment associated with teenage pregnancy. Family planning services also decreased guilt associated with sexual activity. These findings imply that offering family planning services may normalize sexual activity or teenage pregnancy. However, it is important to note that only 3.9 percent of schools offered family planning services, so these implications should be considered carefully given the small sample of schools offering these services (about five schools). This might also explain the result that family planning services decreased expectations for college graduation. An explanation for this finding is not immediately obvious, and it may simply be the product of the small treatment group for this policy variable.

Finally, requiring separate schooling for pregnant students was associated with a stronger belief that the student would have to drop out of school if she became pregnant. This finding suggests that punitive policies such as separate schooling could have the unintended consequence of increasing the likelihood of dropping out for pregnant teens. Importantly, I did not find evidence in Chapter 4 that this policy was protective against the sexual risk-taking behaviors that lead to pregnancy.

Although my research in Chapter 4 focused on how the policy variables were associated with behavioral outcomes such as sexual risk-taking findings from this chapter show that policies can also affect expectations, attitudes, and beliefs. Given the already established relationships between these attitudinal variables and risk-taking behaviors based on other research, it seems that school policy makers should carefully consider how their policies might be designed to have

a beneficial effect on attitudes and expectations that could in turn change behaviors that determine pregnancy risk.

Table 5.1: Variable Means and Standard Deviations
Wave 1, female, never pregnant, unweighted in-home sample
Means not weighted.

	Mean	Std. Deviation
Wave 1 expectation for college graduation	0.862	0.344
Wave 1 expectation for middle class income by 30	0.579	0.494
I would have to quit school if teenage pregnancy	0.199	0.400
Sex would make me feel guilty	0.474	0.499
Teenage pregnancy would not be bad	0.0632	0.243
Teenage pregnancy would be the worst thing that could happen to me	0.871	0.335
Teenage pregnancy would embarrass my family	0.655	0.475
Teenage pregnancy would embarrass me	0.697	0.344
Daycare Indicator	0.170	0.376
Family Planning Indicator	0.0372	0.189
Enrolled in a Separate School (Including Home Tutoring) if Pregnant Indicator	0.279	0.449
Age	15.36	1.670
Latino	0.148	0.355
White	0.548	0.498
African American	0.221	0.415
Other Race	0.0830	0.276
Total Household Income	47.69	56.20
Immigrant	0.0748	0.263
School Size (1-3)	2.292	0.719
Urban	0.291	0.454
Suburban	0.523	0.500
West	0.215	0.411
Midwest	0.250	0.433
Northeast	0.161	0.367
Mother Graduated College	0.287	0.453
Mother High School Graduate/GED	0.340	0.474
Mother Some College	0.223	0.416
Mother No High School Diploma	0.150	0.357

No Father Present	0.425	0.494
Receiving Public Assistance	0.0808	0.272
Religiosity (1-4)	1.827	1.176
Self-Perceived Overweight	0.396	0.489
Instruments:		
Family Planning Clients 20-44 Per Women 20-44 in County	0.0899	0.0545
Proportion of County Conservative Religion	0.166	0.144
Proportion of County Voting Republican, 1992	0.383	0.0882
Proportion of Local Govt Expenditures for Education (County)	0.455	0.135
Observations	4842	

Table 5.2: Marginal Effects for Income Penalty Mechanisms-Exogenous Policies
Estimated on Wave 1, female, never pregnant, in-home sample
* p<0.10, ** p<0.05, *** p<0.01

	(1) Probit-College Expectation b/t	(2) Probit-Mid-Class Income Expectation b/t	(3) Probit- Quit School b/t
Daycare	0.014	-0.012	0.044
	(0.80)	(-0.42)	(1.34)
Family planning services	-0.052**	-0.043	-0.077*
	(-2.29)	(-1.26)	(-1.84)
Enrolled in a separate school	0.021	-0.021	0.084***
	(1.30)	(-0.97)	(2.94)
Age	-0.0027	0.0031	0.013*
	(-0.58)	(0.53)	(1.68)
Hispanic	-0.0076	-0.053	0.011
	(-0.26)	(-1.63)	(0.38)
African American	0.0081	0.022	-0.060**
	(0.44)	(0.98)	(-2.43)
Other race	0.065**	-0.048	0.088**
	(2.13)	(-1.12)	(2.39)
Household income	0.00030	0.00026	-0.000044
	(1.59)	(1.42)	(-0.28)
Immigrant	-0.0033	-0.11***	0.056
	(-0.08)	(-2.68)	(1.33)
School size	0.0060	0.021	0.0010
	(0.53)	(1.49)	(0.06)
Urban	0.016	0.054*	-0.017
	(0.96)	(1.86)	(-0.50)
Suburban	0.013	0.021	-0.037
	(0.85)	(0.83)	(-1.52)
West	-0.080***	-0.0057	0.031
	(-3.73)	(-0.21)	(1.09)
Midwest	-0.036**	0.011	0.016

	(-2.35)	(0.47)	(0.57)
Northeast	-0.033	0.033	0.068*
	(-1.43)	(1.29)	(1.95)
Mother -college graduate	0.095***	-0.0017	0.059**
	(4.31)	(-0.07)	(2.46)
Mother -high school graduate/GED	-0.058***	-0.029	-0.0071
	(-3.35)	(-1.20)	(-0.28)
Mother-no high school diploma	-0.086***	-0.060**	-0.041
	(-3.54)	(-2.17)	(-1.40)
No father present	-0.0037	0.0061	-0.020
	(-0.28)	(0.25)	(-0.89)
Welfare	-0.025	-0.022	0.0046
	(-1.17)	(-0.62)	(0.10)
Religiosity	0.016***	0.016*	0.017*
	(2.64)	(1.89)	(1.78)
Self-perceived overweight	-0.024	-0.050**	-0.0020
	(-1.63)	(-2.44)	(-0.11)
Observations	9932	9932	8356
Subpopulation	4842	4842	3266

Table 5.4: Marginal Effects from Probit Regressions for Psychological Cost of Sex Mechanisms-Exogenous Policies
Estimated on Wave 1, female, never pregnant, in-home sample
* p<0.10, ** p<0.05, *** p<0.01

	(1) Feel Guilty b/t
Daycare	0.045
	(1.43)
Family planning services	-0.087*
	(-1.88)
Enrolled in a separate school (including home tutoring)	-0.035
	(-1.18)
Age	-0.029***
	(-2.96)
Hispanic	0.053
	(1.08)
African American	-0.093**
	(-2.51)
Other race	-0.0097
	(-0.22)
Household income	-0.00013
	(-0.68)
Immigrant	0.11*
	(1.89)
School size	-0.058***
	(-3.30)
Urban	-0.015
	(-0.42)
Suburban	-0.013
	(-0.44)
West	-0.032
	(-0.94)
Midwest	-0.045

	(-1.47)
Northeast	-0.15***
	(-4.44)
Mother -college graduate	-0.013
	(-0.38)
Mother -high school graduate/GED	-0.022
	(-0.64)
Mother-no high school diploma	-0.055
	(-1.43)
No father present	-0.079***
	(-4.05)
Welfare	0.022
	(0.45)
Religiosity	0.10***
	(11.58)
Self-perceived overweight	0.028
	(1.08)
Observations	8355
Subpopulation	3265

Table 5.5: Marginal Effects from Probit Regressions for Cost of Pregnancy Mechanisms-Exogenous Policies
Estimated on Wave 1, female, never pregnant, in-home sample
* p<0.10, ** p<0.05, *** p<0.01

	(1) Pregnancy is not bad b/t	(2) Pregnancy is the worst b/t	(3) Pregnancy would embarrass family b/t	(4) Pregnancy would embarrass me b/t
Daycare	0.0013	-0.021	0.051	0.031
	(0.10)	(-0.70)	(1.53)	(0.89)
Family planning services	0.000017	-0.038	-0.054*	-0.085***
	(0.00)	(-1.00)	(-1.75)	(-3.14)
Enrolled in a separate school (including	-0.0029	-0.0088	-0.036	0.015
home tutoring)	(-0.26)	(-0.43)	(-1.15)	(0.37)
Age	0.010**	-0.019***	-0.0069	-0.020**
	(2.34)	(-3.56)	(-0.77)	(-2.17)
Hispanic	0.046**	-0.014	-0.020	-0.11***
	(2.34)	(-0.57)	(-0.46)	(-2.87)
African American	0.047***	-0.044*	-0.15***	-0.14***
	(3.45)	(-1.86)	(-4.15)	(-3.76)
Other race	0.042*	-0.0025	-0.015	-0.065
	(1.93)	(-0.08)	(-0.27)	(-1.30)
Household income	0.000048	0.00020	0.00050*	0.00064*
	(0.36)	(1.08)	(1.92)	(1.85)
Immigrant	-0.029	0.013	0.100**	0.079*
	(-0.96)	(0.46)	(2.15)	(1.73)
School size	-0.00067	-0.013	-0.0095	-0.0050
	(-0.13)	(-0.84)	(-0.62)	(-0.26)
Urban	0.0068	0.012	-0.017	-0.020
	(0.47)	(0.51)	(-0.55)	(-0.60)
Suburban	0.022**	-0.028	-0.028	-0.031
	(2.17)	(-1.36)	(-1.11)	(-1.04)
West	-0.017	-0.032	-0.024	-0.014

	(-1.12)	(-1.39)	(-0.60)	(-0.32)
Midwest	-0.033***	0.0089	0.015	0.10***
	(-2.66)	(0.37)	(0.50)	(2.83)
Northeast	-0.014	0.0098	0.033	0.065*
	(-1.06)	(0.41)	(0.84)	(1.68)
Mother -college graduate	0.018	0.0060	0.064**	0.036
	(0.99)	(0.29)	(2.24)	(1.09)
Mother -high school graduate/GED	0.027*	-0.015	0.012	-0.033
	(1.78)	(-0.78)	(0.45)	(-1.28)
Mother-no high school diploma	0.031	-0.032	-0.073	-0.051
	(1.53)	(-1.18)	(-1.29)	(-1.49)
No father present	-0.00066	-0.013	-0.082***	-0.034*
	(-0.06)	(-0.96)	(-3.42)	(-1.67)
Welfare	0.018	0.026	0.033	0.020
	(0.81)	(0.86)	(0.64)	(0.46)
Religiosity	-0.0066	0.017***	0.054***	0.056***
	(-1.54)	(2.86)	(4.55)	(6.72)
Self-perceived overweight	0.022*	-0.037*	-0.012	-0.033*
	(1.80)	(-1.95)	(-0.49)	(-1.75)
Observations	8379	8381	8359	8365
Subpopulation	3289	3291	3269	3275

CHAPTER 6

CONCLUSION

OVERVIEW

This dissertation focused on how school policies related to student reproductive health affect the sexual decisions for female students who have never been pregnant; these sexual decisions in turn affect the risk of pregnancy. I first conducted a literature review of the extant work in this area. Overall, the research published to date on the effect of school-level policies on student sexual behaviors has been largely based on studies with a small number of schools. My dissertation extended this area by researching the effect of school policies using a nationally representative dataset on more than 130 schools. Additionally, although the effect of family planning services on student sexual behaviors and pregnancy risk has been studied, I found no analyses of the effects of school-linked daycare, or of requiring separate schooling for pregnant students, on student sexual behaviors. I also did not find any study that examined the impact of school policies related to reproductive health on student expectations for the future or sex/pregnancy attitudes. However, I did find evidence that expectations for the future and sex/pregnancy attitudes have been linked to sexual risk-taking behaviors in existing studies.

I then developed a dynamic model of student decision-making with regard to protected and unprotected sexual activity to explore how different parameters might affect these choices; this model ultimately guided my thinking about how school policy could intervene on these decisions.

In Chapter 4, I analyzed the effect of three school policies related to student reproductive health (school-linked daycare, family planning services, and requirement separate schooling for pregnant students) on sexual behaviors that determine pregnancy risk for never-pregnant female students. Overall, I found evidence that family planning services seemed to increase pregnancy risk through higher sexual frequency during the school year. In a second model of the choice between seven sexual strategies (defined as varying levels of sexual frequency and birth control use) I found that family planning services increased the probability that a student chose medium or high sex frequency (with at least some birth control use) sexual strategies. I also found evidence that providing school-linked daycare increased the likelihood of low sex frequency with at least some birth control. I found no effect of the separate schooling requirement on student sexual behaviors.

Chapter 5 focused on how these same policies might affect the preference or expectation parameters identified in my theoretical model. I modeled the effect of these policies on student expectations for the future related to: human capital formation, the psychological cost of teenage sexual activity, and the expected disutility of teenage pregnancy. Family planning services seemed to normalize teenage pregnancy and sexual activity based on the result that it decreased expected embarrassment associated with becoming pregnant as a teenager and decreased guilt associated with sexual activity. Separate schooling policy had the unfortunate effect of increasing the likelihood that a student believed she would have to drop out of school if she became pregnant.

POLICY IMPLICATIONS

These findings suggest important policy implications for school policymakers and others interested in reducing teenage pregnancy. First, it is important to note that my results imply that school policies can intervene on: student sexual behavior decisions, student expectations, and student sex/pregnancy attitudes that have been linked to sexual risk-taking behaviors.

With regard to school-linked daycare, the policy implications are not very encouraging. I found that providing school-linked daycare was associated with an increased risk of being in the low sex frequency (1-3.14 sexual encounters) with at least some birth control category, which should result in relatively low pregnancy risk. However it is important to note that this implies that daycare may serve to increase transition into sexual activity for some students (who move from the "no sex" to the "low sex frequency, some birth control" category). Policymakers considering this option for their students should take potential for accelerating transitions into sexual activity into account. I did not find evidence that school-linked daycare affected student expectations or sex/pregnancy attitudes. Thus, while there are clear resource costs associated with daycare in schools, I found little evidence of consistently large benefits in terms of reducing pregnancy risk for students. Of course, reducing pregnancy risk for never-yet-pregnant students in schools is only one policy goal for schools offering daycare.

Offering family planning services was associated with increased pregnancy risk for students. More specifically, this policy increased frequency and the likelihood of a student being in the medium- or high-sex frequency groups with some birth control. This policy was also related to expectations and sex/pregnancy attitudes in a way that suggests providing family planning services destigmatize sex and teenage pregnancy. Although only a small proportion of schools in the sample offered family planning services, these findings do provide some evidence

that offering family planning services might have the unintended consequence of increasing pregnancy risk and making teenage pregnancy seem more acceptable.

Finally, separate schooling for pregnant students was associated with a higher belief that a student would have to quit school if she became pregnant. This finding should be of interest to policymakers since separate schooling arrangements for pregnant students are presumably designed in an attempt to help such students stay in school and provide targeted assistance to students in need. However, my findings indicated that students likely view this policy as punitive in nature. Surely the goal of requiring separate schooling for pregnant students is not to make a student believe that she would have to quit school if she became pregnant. However, instead of reporting that they would be less likely to have to quit school in the event of pregnancy (which would be the expected result if students perceived separate schooling arrangements as helpful) students were more likely to report that they would have to quit school if they became pregnant when separate schooling was the policy. This suggests that when providing separate schooling to pregnant students, educational policy makers should consider how this policy may be negatively viewed by students. Ultimately, if the goal of offering separate schooling arrangements is to help pregnant students be successful, policymakers should consider that such segregation appears to be seen by students as more of a punishment than a service.

Overall, my findings underscore the importance of schools in teenage pregnancy prevention. School policies can affect both student choices about sexual activity and contraceptives and their expectations and sex/pregnancy attitudes. School policy makers should carefully consider how their policies might have potential unintended consequences, such as family planning services destigmatizing sexual activity or pregnancy and separate schooling

policies increasing the likelihood that a student thinks she would have to quit school if she became pregnant. If educators wish to adopt these policies, my research suggests that additional educational opportunities (such as providing assurances about the advantages and greater resource availability for pregnant students associated with a separate school) should go hand-in-hand with the policies when implemented.

LIMITATIONS AND FUTURE RESEARCH

This dissertation provides preliminary evidence regarding the effect of school policies related to student reproductive health on sexual choices, pregnancy risk, expectations, and sex/pregnancy attitudes. Although I did not find empirical evidence of policy endogeneity in these analyses, I plan on investigating this issue further. In subsequent research, I will study potential issues with sample selection from excluding male students and female students who had been pregnant as of Wave 1. Another important point that underscores the preliminary nature of the findings presented here is the amount of missing data. Recall that the sample size dropped by about half once missing observations for the independent variables were accounted for. In future research, I plan to investigate this issue more fully and attempt to address it using imputation. For these reasons, the findings here should be considered preliminary and subject to change upon further analyses.

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APPENDIX A

DESCRIPTION OF VARIABLES

DEPENDENT VARIABLES

1. **Any sex:** In the relationship files, each respondent was asked to identify a list of events that happened during each relationship that they were in that spanned the last 18 months. One of these activities was sex. If they indicated that they were sexually active during this relationship based on this question, they were then asked a follow-up question about whether or not they had vaginal intercourse during that relationship. If they did not list sexual activity in the screening question, they were skipped out of the follow-up question. I coded any sex as equal to 1 if they indicated that vaginal intercourse had occurred in the relationship and zero otherwise. I aggregated these measures across relationships so that if the respondent reported vaginal intercourse in at least one relationship, they received a 1 for this outcome variable.
2. **School year sex frequency:** I created a measure of school year sex frequency by identifying the number of relationship days that occurred during the school year and multiplied this by each relationship's sex per day measure. This created a school year frequency that I summed across up to six relationships for each respondent.
1. **Any birth control use:** Sexually active respondents were asked if they used any birth control during each relationship. If they responded positively to this question, they were then asked to list up to three types of birth control. I coded this variable as equal to 1 if

the respondent indicated that she always or sometimes used birth control in the relationship. I used the list of birth control options to ensure that only legitimate forms of contraception were included. For example, I did not include withdrawal, spermicides, or the rhythm method as legitimate forms of birth control. I aggregated this variable across relationships such that if a respondent indicated that she at least sometimes used birth control in at least one relationship, she received a 1 for this outcome variable.

1. **Sexual strategies:** I broke school year sex frequency into high, medium, and low categories at the 25th, 75th, and greater than 75th percentiles. Within each level I created two variables: one with any birth control use and one with no birth control use. This measure takes information about up to six relationships and aggregates it into a set of sexual strategies characterized by frequency and contraceptive use that lead to varying levels of pregnancy risk.

KEY INDEPENDENT VARIABLES

2. **Daycare indicator variable**: This variable is equal to one if the school administrator responded that the school either offered daycare on campus or that daycare was provided at another school in the district, otherwise (referred to another provider / neither provided nor referred) it is equal to zero.
3. **Family planning services indicator variable**: This variable is equal to one if the school administrator responded that the school either offered family planning services on campus or that the services were provided at another school in the district, otherwise (referred to another provider / neither provided nor referred) it is equal to zero.

4. **Separate school indicator variable**: This variable is equal to one if the school administrator responded that the school requires pregnant students to attend a separate school (including home-schooling), otherwise it is equal to zero.

CONTROL VARIABLES

1. **Age**: a continuous measure of the respondent's age.
2. **African American**: a dichotomous indicator of the race/ethnicity of the respondent that equals 1 if the respondent is African American and 0 if the respondent is not African American.
3. **Hispanic**: a dichotomous indicator of the race/ethnicity of the respondent that equals 1 if the respondent is Hispanic and 0 if the respondent is not Hispanic.
4. **White**: a dichotomous indicator of the race/ethnicity of the respondent that equals 1 if the respondent is white and 0 if the respondent is not white.
5. **Other race**: a dichotomous indicator of the race/ethnicity of the respondent that equals 1 if the respondent is not white, not African American, and not Hispanic, and 0 if the respondent is not is one of these three categories.
6. **Immigrant**: a dichotomous indicator of the immigrant status of the respondent that equals 1 if the respondent is an immigrant and 0 if the respondent is not an immigrant.
7. **Household income**: household income reported in $1,000.
8. **School size**: an ordered variable ranging from 1-3 indicating the size of the school, where 1=small (1-400 students); 2=Medium (401-1,000 students); and 3=large (1,001-4,000 students).

9. **Urban**: a dichotomous indicator of the urbanicity of the respondent's school that equals 1 if the respondent's school is in an urban area and a zero otherwise.
10. **Suburban**: a dichotomous indicator of the urbanicity of the respondent's school that equals 1 if the respondent's school is in an suburban area and a zero otherwise.
11. **Rural**: a dichotomous indicator of the urbanicity of the respondent's school that equals 1 if the respondent's school is in an rural area and a zero otherwise.
12. **West**: a dichotomous indicator of the region of the respondent's school that equals 1 if the respondent's school is located in the Western region and a zero otherwise.
13. **Midwest**: a dichotomous indicator of the region of the respondent's school that equals 1 if the respondent's school is located in the Midwestern region and a zero otherwise.
14. **Northeast**: a dichotomous indicator of the region of the respondent's school that equals 1 if the respondent's school is located in the Northeastern region and a zero otherwise.
15. **South**: a dichotomous indicator of the region of the respondent's school that equals 1 if the respondent's school is located in the Southern region and a zero otherwise.
16. **Had non-resident father at wave 1**: The survey asks a separate set of questions to the adolescent about their biological father is the father is not a member of their household. This variable is an indicator of whether the non-resident father questions were asked of the adolescent at the wave 1 interview.
17. **Had non-resident mother at wave 1**: The survey asks a separate set of questions to the adolescent about their biological mother is the mother is not a member of their household. This variable is an indicator of whether the non-resident mother questions were asked of the adolescent at the wave 1 interview.

18. **Mother's Education**: The adolescent is asked about her biological mother's highest level of education.

    1. **Less than High School**: a dichotomous indicator variable for mother's education that equals 1 if the mother has less than high school education, as reported by the adolescent, and equals 0 otherwise.
    2. **High School Graduate/GED**: a dichotomous indicator variable for mother's education that equals 1 if the mother graduated high school or received a GED, as reported by the adolescent, and equals 0 otherwise.
    3. **Some College**: a dichotomous indicator variable for mother's education that equals 1 if the mother attended college but did not graduate, as reported by the adolescent, and equals 0 otherwise. This category is omitted from the regression and thus serves as the reference category.
    4. **College Graduate**: a dichotomous indicator variable for mother's education that equals 1 if the mother graduated college, as reported by the adolescent, and equals 0 otherwise.

19. **No father present:** a dichotomous indicator variable for family structure that equals 1 if the father is present in the home and zero otherwise.
20. **Welfare:** a dichotomous indicator variable that equals 1 if the family received welfare and zero otherwise.
21. **Religiosity:** a four-point likert-type scale indicating religious attendance ranging from never to once a week or more.

22. **Self-perceived overweight:** a dichotomous indicator variable that equals one if the respondent reported that she though of herself as slightly overweight or very overweight and is zero otherwise.

23. **% of students who are African-American**: this school-level variable was created by aggregating individual student responses to the question "What is your race?" in the in-school survey of all students. The variable represents the percent of students in the school who marked African American as his/her race.