# Social Norms and Sexual Activity in U.S. High Schools

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ABSTRACT

*This paper estimates a formal model of social norms with multiple equilibria using data from the Add-Health Survey of 20,000 U.S. high school students. The results suggest that there is considerable diversity in social norm equilibria, with some schools enforcing norms against sexual activity and others not doing so. The rate of sexual activity is about 5 percent lower in schools with norm-enforcing equilibria, suggesting that social norm effects are neither trivial nor decisive. Still, the most consistently significant factor affecting teen sexual activity is not the social environment or the school, but rather the family.*

## I. Introduction

A great deal of attention has recently been focused on the possibility that interpersonal interactions have a strong influence on individual behavior.[1] Social and economic theories have identified mechanisms by which rational, self-interested

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1. See Etzioni (1993), Putnam (1995), and Shalit (1998).

individuals may, in groups, have some influence on the behavior of group members.[2] These kinds of theories have been applied in a wide variety of contexts.[3] Despite the apparently widespread confidence in the usefulness of such theories, empirical studies have given them surprisingly little support. Reviews of the literature generally conclude that the empirical evidence on social effects is weak (Jencks and Mayer 1990).

This paper tests for social effects using the standard method of empirical economics: build a simple theory and then estimate the equations it implies. This kind of approach has not been all that popular in the literature, mostly because even the simplest of social norm theories has multiple equilibria. Accounting for two or more equilibria in the data substantially complicates the econometrics, and so the literature tends to be dominated by reduced-form studies (Brooks-Gunn, Duncan, and Aber 1997; Case and Katz 1991; Crane 1991; McAlister, Krosnick, and Milburn 1984).[4] The results have been unsatisfactory, but it is not clear what to make of this.[5] Perhaps the reduced-form approach, in removing the possibility of multiple equilibria, essentially fails to test the theory. Or perhaps social effects simply do not exist. Some existing evidence points directly to the possibility that what seem to be social effects are just selection effects: individuals who share the same tastes tend to group together, and this creates a positive correlation between the group's behavior and the individual's behavior (Plotnick and Hoffman 1999; Evans, Oates, and Schwab 1992).[6] Thus, to truly test the theory, it would be necessary not only to allow for multiple equilibria, but also to measure the extent to which different equilibria impose different degrees of actual social force on individual behavior. This paper presents and tests a model with these features. Specifically, we will derive a likelihood function in which each student's apparent sensitivity, or lack of it, to the sexual activity

2. A large but undoubtedly incomplete list of theoretical papers showing social effects would include: Schelling (1960), Coleman (1990), Holländer (1990), Kandori (1992), Kandori, Mailath, and Rob (1993), Young (1993), Bernheim (1994), Binmore and Samuelson (1994), Goyal (1996), Heckathorn (1996), Sugden (1996), Bicchieri, Jeffrey, and Skyrms (1997), Eshel, Samuelson, and Shaked (1998), Harrington (1998).

3. This includes such topics as partnerships (Kandel and Lazear 1992), tax evasion (Cowell 1990), welfare policy (Bird 1999; Besley and Coate 1992; Lindbeck, Nyberg, and Weibull 1998), trade reputations (Greif, Milgrom, and Weingast 1994; Kreps 1990), teen pregnancy (Nechyba 1999), unemployment (Montgomery 1994; Akerlof 1980), common-pool resource management (Sethi and Somanathan 1996), revolutions (Lohmann 1997; Kuran 1991), footbinding (Mackie 1996), culture (Boyd and Richerson 1990), law (Sunstein 1996), and redistribution (Bowles and Gintis 1994).

4. These literatures are too extensive to be given justice here. Also, note that there is a large literature in psychology based on experiments with peer groups; for example, see Trafimow (1994). While experiments can show that something like social motivation exists, they cannot estimate how generally important that motive may be in determining real-world behavior.

5. Manski (1993) has argued that reduced-form linear models of social effects will be unidentified. This is not an issue for nonlinear equations such as those used here. The issue will be discussed more fully below.

6. Other studies that have used formal modeling and theory to support empirical research on social effects include Moffitt (1983) and Glaeser, Sacerdote, and Scheinkman (1996). Moffitt finds indirect evidence that something makes a dollar of welfare worth less than a dollar of regular income, but it is not clear that it is a social effect (stigma) or something else. Similarly, Glaeser, Sacredote, and Scheinkman find that the behavior of neighbors has a direct effect on other neighbors, but they do not attempt to identify a specific social mechanism (stigma, information, etc.)

decisions others, will be used to predict whether the local equilibrium is more or less punitive.

The model will focus on social norms regarding sexual activity. While this particular application of the theory is new, the model itself is not significantly different from other simple models of social conformity effects (see Footnote 3). The model is applied to sexual activity because it is an area with important policy implications, especially for the poor (Kane and Staiger 1996; An, Haveman, and Wolfe 1993; Akerlof, Yellen, and Katz 1996; Clarke and Strauss 1998; Nechyba 2001; Bird 1999, SIECUS 1999).[7] Policy arguments about social norms tend to revolve around the possibility that certain policies, with direct negative effects on teen sexual activity, may have indirect positive effects through their influence on norms. Offer sex education in the schools, so the argument goes, and you may indeed discourage some sexual activity. However, in normalizing the subject you may so weaken students' moral resolve to abstain (such as it is) that sexual activity rises. Bird (1999) shows that norms and policies can indeed be substitutes: government policies do some of the work that norm-enforcing individuals would otherwise so, and so these individuals react to tougher policies by reducing their costly punishment activities, weakening the norm. As for poor communities, the same paper shows that norm enforcement falls with income and that richer communities tend to be more tolerant. The social capital movement assumes the opposite, blaming social ills on an ostensible lack of norm enforcement in low-income communities. A formal model of social norms of sexual activity will allow direct tests of the substitution effect as well as any income effect.

The paper is organized as follows. Section II presents a model of sex norms in schools. Section III draws out empirical implications and estimable behavioral equations. Section IV discusses the data, from the National Longitudinal Study of Adolescent Health, or "Add-Health." Section V presents results for the model as applied to teen sexual activity. Section VI concludes. An Appendix contains existence proofs for the model's equilibria.

## II. A Model of Sexual Activity and Social Norms in Schools

Consider a school with $N+1$ students, indexed $i = 1, \ldots, N+1$. A student can choose to be sexually active ($s_i = 1$) or not ($s_i = 0$). Sexual activity provides a utility increment $\varepsilon_i$ but imposes a nonnegative material cost $c$.[8] We will assume that the material cost, $c$, is the same for all students, but that the utility of sexual activity, $\varepsilon$, is distributed i.i.d. according to some distribution function $F(.)$, with $F$ having support on the entire real line.

7. There is a large literature on teen pregnancy; these references are indicated only as a start.
8. The cost will be reduced if welfare benefits are available to single mothers. There is no need to model this possibility explicitly; one can simply think of a policy change in favor of single mothers as a change that lowers $c$.

Both benefits and costs include the entire expected impact of sexual activity; $\varepsilon_i$ can be negative. Each student is endowed with an income $y_i$, which provides utility according to a continuously differentiable function $u(y)$, with $u' > 0$, $u'' < 0$.

In a given time period, each student interacts with the other $N$ students individually.[9] In each pairing, the two players observe one another's circumstances and sexual behavior choice.[10] Each agent may then choose to impose a punishing stigma on the other player. The cost of imposing stigma is $\theta$ and the cost of having stigma imposed is $\varphi$.[11]

In general, punishment could be imposed by any player for any reason, but it is useful to restrict the strategy space to the following: Agents choosing a *punishment strategy* ($p_i = 1$) will impose stigma on other players who (a) are sexually active, or (b) have not adopted the punishment strategy, or both. Agents who do not adopt the punishment strategy have $p_i = 0$. The punishment of nonpunishment is necessary to support punishment as an equilibrium strategy (Sethi and Somanathan 1996). Since individuals receive only costs and no benefits from imposing stigma, it is necessary that the failure to impose stigma be penalized itself; otherwise norms cannot exist as equilibrium behavior.[12] Note this does not mean that we have assumed that they must exist. There may still be equilibria in which nonpunishment is universal; there may also be equilibria in which only some of the sexually nonactive students stigmatize the sexually active students. So far, the mechanism merely allows punishment as an option. It remains to be seen whether stigma of any kind can be supported as equilibrium behavior.

For each student, a strategy involves choosing whether to be sexually active ($s$), and whether to punish others ($p$). Let $v$ be the percent of the student body that is sexually

9. In assuming that students interact with all members of their school, I implicitly define the school as the student's peer group. This is necessary because with school-level data it is not possible to identify peer groups at a finer level. One consequence that should be noted is that the existence and nonexistence arguments for various equilibria depend on the possibility of extreme values of $\varepsilon$, which in turns requires indefinitely large values of N. These arguments will be less plausible as school size gets smaller.

10. In a more realistic model, one should relax these strong assumptions about the observability of sexual activity. The easiest way to do this would be to replace the assumption that agents interact with all N other agents and instead they interact—in a way meaningful for norm enforcement—only with some fraction $\omega N$, where $\omega$ represents the probability that the sex activity choice is observed. In the model in the paper, one can simply think of $N$ as being smaller if observability issues seem important; any comparative static results on $N$ are implicitly comparative statics about the ability to hide sexual activity. Given, however, that sexual activity always involves two people, and that the people involved are unlikely to be masters of deception, and that there is often considerable pressure to report activity, it seems implausible that a pattern of sexual involvement by any one teen would go unnoticed by other teens for very long. So observability—clearly a major problem for researchers who are, after all, adults *and* on the outside—probably is less of a problem for the teens themselves. An accurate modeling of the interaction between reported behavior and observed behavior (with all the incentives involved) would be much more complex than appropriate for this paper, in which the model is mostly intended to set up an empirical study.

11. In principle, stigma may be individual-specific. However, trial estimates of this model with heterogeneous stigma produced no systematic evidence of differences in stigma among students with different characteristics. Therefore stigma costs will be treated as a constant.

12. Actually the punishment of nonpunishment should be infinitely recursive in order to fully purge punishment behavior of its public-good character (Bendor and Swistak 1997). The model could be expanded to allow infinite recursion by defining a teen to be either in good standing or bad standing (for any bad act, including nonpunishment at any level of recursion), with teens in bad standing being punished by those in good standing. I use only one level of punishment just to keep the exposition simple.

active and let $\pi$ be the fraction that punishes. Students choose strategies to maximize the objective function $W(s_i, p_i)$:

$$(1)\quad W(s_i, p_i) = u(y_i - cs_i) + \varepsilon_i s_i - \pi N(\varphi s_i + \varphi((1 - p_i) - s_i (1 - p_i))) - (1 - \pi + v\pi)N\theta p_i$$

The first term is the utility of income; the second is the utility effect of sexual activity. The third is the cost of being stigmatized, and it derives from being stigmatized by $\pi N$ other students, at a cost of $\varphi$ for each one, if $s_i$ (sex), $(1-p_i)$ (nonpunishment), or both, are equal to one. The fourth term is the cost of adopting the punishment strategy, again deriving from having to punish those who are having sex and those who are not punishing, which comes to $N(1\text{-}\pi + v\pi)$ other agents, at a cost $\theta$ for each, if $p_i$ equals one.

The objective function takes the following values depending on the choices taken:

1. $W(0,1) = u\ (y_i) - (1 - \pi + v\pi)N\theta$
2. $W(0,0) = u\ (y_i) - \pi N\varphi$
3. $W(1,0) = u\ (y_i - c) + \varepsilon_i - \pi N\varphi$
4. $W(1,1) = u\ (y_i - c) + \varepsilon_i - \pi N\varphi - (1 - \pi + v\pi)N\theta$

In general, such a model would allow a large number of equilibria. To reduce the equilibrium set to an empirically tractable size, consider the following three assumptions:

*Assumption 1*: In any given school population, there will always be at least one student who prefers to be sexually active, even if all other students have chosen to punish sexual activity.

*Assumption 2*: In any given school population, there will always be at least one student who prefers to be sexually inactive, even if no students have chosen to punish sexual activity.

*Assumption 3:* Any student who is indifferent between Strategies 1 and 3 (punish/no sex and no punish/sex) will choose Strategy 1.

The first two assumptions are probably most reasonable in schools with large populations. In a large population, it is likely that even in the most extreme cases of universal punishment or nonpunishment, there would be one student with a value of $\varepsilon$ high enough or low enough to go against the mainstream. In a small population school, these assumptions are less tenable. The third assumption concerns a knife-edge case; as can be seen in the appendix, it is possible that a school will have certain values of the parameters $\varphi$ and $\theta$, and, in a certain equilibrium, values of the aggregate behavior variables $\pi$ and $v$, such that $\pi\varphi = v\theta$. In this situation, which is probably rare in practice, the number of punishers and nonpunishers is not identified, because sexually inactive students are indifferent between punishing and not punishing. As a result, the theory does not identify the costs of stigma, making this an empirically intractable case. This third assumption simply eliminates it, in order to keep the empirical work as simple as possible.

Under these assumptions, Strategy 4 (have sex, punish) will be strictly dominated by Strategy 3 (have sex, do not punish). Because there is always at least one sexually active student, who must be stigmatized, imposing punishment will always have some cost. Hence Strategy 3 will be preferred over Strategy 4.

This leaves Strategies 1, 2, and 3. Let $x_1$, $x_2$, and $x_3$ represent the fraction of the school population playing each strategy. Having assumed that there are always some sexually active students, we can immediately rule out equilibria involving $x_1 = 1$, $x_2 = 1$, and $x_3 = 0$, since each of these has no sexually active students. In the same spirit, we can also rule out $x_3 = 1$ as an equilibrium. This equilibrium would mean universal sexual activity, which is as unlikely as universal abstinence. With ε being distributed on the entire real line, there will always be some positive probability on values of ε low enough that the students with these values would choose not to be sexually active. Again, I will assume this is the case, eliminating $x_3 = 0$.

This leaves two equilibria:

*Proposition. Under Assumptions 1–3 above, the preceding model has the following two equilibria:*

*A. Permissive:* $\pi = 0$, and $v = \sum_i I[\varepsilon_i > u(y_i) - u\,(y_i - c)]/(N+1)$

*B. Punitive:* $\pi\varphi > v\theta$, $\pi = 1 - v$, and

$$v = \sum_i I[\varepsilon_i > u(y_i) - u(y_i - c) + (1 - v)\,N\varphi - vN\theta]/(N+1)$$

*where I[.] is the indicator function.*

Proof: see the appendix.

The permissive equilibrium occurs when $x_1 = 0$. No one punishes anyone and sexual activity is undertaken only by those who find it individually beneficial, without any thought of social norms. Thus, there exists an equilibirum in which norms effectively are not enforced. However, there also exists an equilibrium in which norms are enforced; this is the punitive equilibrium, with $x_2 = 0$. In it, students face a choice: either to be sexually active and be stigmatized by others, or to be sexually abstinent and be the stigmatizers of the sexually active. Students will be sexually active if their inherent utility of sex (ε) is high enough to overcome the stigma. In addition, sexually active teens get the benefit of *not* having to bear the costs of imposing stigma. The cost of imposing stigma is born by the other students, the ones who punish. For these students, the costs of imposing stigma ($v\theta$), while real, are less than the cost of having stigma imposed on them ($\pi\varphi$)—which will happen if they refuse to go along with the punishment strategy. Thus, each punishing teen has decided that the value of sexual activity (ε) is not worth the *net* stigma cost—the net effect of being stigmatized by other punishers, minus the benefit of not having to do any stigmatizing.

A simple numerical example clarifies the workings of the model. Let $u(y)$ be linear in $y$, so that $u(y) - u(y - c) = c$. Suppose a school has 101 students, with 20 students having $\varepsilon = 5$ and 81 having $\varepsilon = -5$ (note that this is not consistent with the distributional assumptions for ε above). Let the cost of sexual activity be set to $c = 1$. Finally, suppose that the cost of imposing and receiving stigma is the same, with $\varphi = \theta = 0.05$. In the permissive equilibrium, students choose $s = 1$ if and only if $\varepsilon > c$. For the 20 students with $\varepsilon = 5$, this is true, and therefore 20 students are sexually active. The remaining students are sexually inactive. None of the inactive students would choose to impose stigma, because it would impose a cost of 100*(0.05) = 5 on them, with no benefit. Hence the permissive equilibrium is indeed an equilibrium. The punitive equilibrium says that students are sexually active if $\varepsilon > c + (1-v)*100*0.05 - v*100*0.05$; otherwise they punish. Suppose the students with $\varepsilon = 5$ all chose to be sexually active. Then $v$, the violation rate, would be approximately 0.20. With $c = 1$, the choice equation is $\varepsilon > 1 + (0.81)*5 - (0.2)*5$, which reduces to $\varepsilon > 4.05$. Hence, the 20 students with $\varepsilon = 5$ would indeed be sexually active, and those with $\varepsilon = -5$ would not be. The violation rate of $v \approx 0.2$ is therefore consistent with optimizing behavior. As for punishment, the 81 students who are not sexually active will punish the sexual active students if and only if the price they pay for not punishing exceeds the cost of punishing. The cost of punishing when $v = 0.2$ are (0.2)*100*(0.05) = 1. The cost of not punishing is the stigma one will bear from the other punishers, which is 80*(0.05) = 4.05. Therefore, it is individually rational for the sexually inactive students to punish. This simple example shows how both the permissive and the punitive outcomes can be supported as equilibria by rational individuals.

## III. Empirical Implications of the Model

The model connects a number of observable variables in various ways, and the connections are specific enough to allow estimation of the model's structural parameters. The Conditions A and B above which define the two equilibria can be interpreted as choice equations that should hold in the data. In a permissive equilibrium (Condition A), each teen chooses to be sexually active if and only if

(2) $\varepsilon_i > u(y_i) - u(y_i - c)$

where $y$ is agent income and $c$ is the cost of sex. In a punitive equilibrium (Condition B), the rate of violation, $v$, equals the rate of nonpunishment, $1\text{-}\pi$. Thus, after rewriting, Condition B implies that a teen is sexually active if and only if

(3) $\varepsilon_i > u(y_i) - u(y_i - c) + N((1 - v)\varphi - v\theta))$

where $N$ is the school size, $v$ is the rate of sexual activity in the school, $\varphi$ is the stigma received per encounter by students who violate the norm, and $\theta$ is the per-encounter cost of imposing stigma. In other words, the equilibrium conditions derived from the simple model imply two simple choice equations, one that holds under the permissive equilibrium and the other that holds in the punitive equilibrium.

Let the utility increment of sexual activity be redefined as a linear function of $i$'s characteristics $\tilde{x}_i$, so that $\varepsilon_i = \tilde{\beta}\tilde{x}_i + \eta_i$ where $\eta$ is a disturbance term. The choice equation in permissive equilibrium becomes $\eta_i > -\tilde{\beta}\tilde{x}_i + u(y_i) - (y_i - c)$. Next because $c$ cannot be observed, assume that the income terms can be expressed as $u(y_i) - u(y_i - c) \approx \gamma y_i$, that is, as a linear function of income.[13] Then define the matrix

13. There is a great deal of disagreement even among social scientists about the true lifetime monetary costs of sexual activity, and especially pregnancy, among teenagers (Hotz, Mullin, and Sanders 1997; Oettinger 1999).

$x_i$ as $\tilde{x}_i$ concatenated with $y_i$, so that the choice equation can be expressed in the following simple way: $s_i$ equals 1 if and only if

(4) $\eta_i > -\beta x_i$

Applying the same modifications to the punitive equilibrium, we have that $s_i$ equals 1 if and only if

(5) $\eta_i > -\beta x_i + \varphi(1 - v)N - \theta v N$

These equations are the basis of estimation in the two equilibria.[14]

Although simple techniques could be used to estimate these equations, there is a difficulty in that different equations apply in different equilibria, and the equilibria are not observed. Moreover, if parental and student preferences are correlated, the equilibrium state will be endogenous. Parents can choose the schools their children will attend, and they may systematically select schools in one or the other equilibrium state. To account for the selection, let student $i$, with characteristics $z_i$, be in a punitive equilibrium if and only if

(6) $\delta z_i + \alpha_i > 0$

where $\alpha$ is a disturbance term. Let $\alpha$ and $\eta$ be distributed bivariate normal with zero means and covariance $\Sigma$; let the correlation between $\alpha$ and $\eta$ be $\rho$. Note that we are accounting for unobserved heterogeneity, specifically the possibility of correlations between students' unobserved tastes for sex and parents' unobserved tastes for punitive schools.[15] Using the distributional assumptions above and the decisions rules in Equations 4, 5, and 6, the probability of sexual activity for observation $i$ becomes

(7) $pr(s_i = 1 \mid x_i, z_i) = CDFN(\beta x_i, -\delta z_i, \rho) + CDFN(\beta x_i - \varphi(1 - v)\, N + \theta v N, \delta z_i, \rho)$

where CDFN is the bivariate normal cumulative distribution function with correlation coefficient $\rho$. The first term is the joint probability of sexual activity and permissive equilibrium, and the second is the joint probability of sexual activity and punitive equilibrium. The likelihood function for the entire model involves the joint probability of Equation 7, across the entire sample.

Perhaps the most intuitive way to understand the approach is to think of it as an attempt to estimate a model in which a population is mixed, with a probability $p$ of being in one state (permissive equilibrium) and a probability 1-$p$ of being in the other (punitive equilibrium). The states are not observed, but we can use external information (parental choice as correlated to parental characteristics) to predict the state.

14. The econometric structure of Equation 5 deserves some attention. Let x and z be student and school characteristics, and express $v$, the average rate of sexual activity in the school, as $E(s \mid z)$. Now write the regression of $s$ on characteristics $x$ and $v$ as a conditional expectation function: $E(s \mid x,z) = \beta x + \gamma E(s \mid z)$. An identification problem becomes apparent. The expectation $E(s \mid z)$ appears on both sides, and because expectation is linear, it can be carried through to cancel that term, leaving the parameters $\gamma$ and $\beta$ unidentified. (This is a rough version of the intuition behind Manski's 1993 critique of such models.) Note, however, that the equation in this paper (Equation 5) does not have this problem. It is a probit problem and not a linear regression; the expectation operator cannot be carried through. The curvature of the probit allows the identification of $\gamma$.

15. In the empirical work the correlation between unobserved tastes for sex and unobserved tastes for punitive schools is strongly negative, as one might expect (on the order of –0.8).

The model is identified in that the terms $vN$ and $(1\text{-}v)N$ enter the sexual activity equation only in the punitive equilibrium. Thus, the results which maximize the likelihood function will be those which most accurately sort the students into two groups: those whose sexual activity decisions seem to be influenced by the number of sexually active and sexually inactive students in their schools ($vN$ and $(1\text{-}v)N$, respectively), and those whose decisions seem not to be influenced by these variables.

It is, in fact, a further and ultimately ad hoc assumption to conclude that the empirical equilibrium in which students are influenced by peers has been produced from the theoretical equilibrium we have labeled "punitive." In terms of sheer mechanics, the estimator here simply sorts the students into groups, and we cannot know that a peer-influenced group is living in a punitive equilibrium, or that a group without peer influences is in a permissive equilibrium. It seems conceptually sensible to assume this is so, but the econometrics do not, in fact, ensure this association.

An alternative approach to the data that does not suffer from imposing an ad hoc equilibrium-selection equation is to assume one equilibrium is in force at all schools, and estimate the model under that assumption (see Moro 2003). Then switch the equilibrium assumption and estimate the model again. Each reestimation produces a new set of parameter estimates for the theoretical model, and these parameters can then be used to generate a predicted distribution of equilibria in the data. The distributions produced under different initial assumptions are reliable information on the actual distribution of equilibria, in that they do not depend on the specification of an ad hoc selection equation. Moro shows that the fundamental parameters of the model can be directly estimated with this method. Application of the Moro method to the issues around sexual activity norms would be a good avenue for future research.

Returning to the sorting equation method, in order to identify the sorting equation, the $z$ matrix and the $x$ matrix cannot be the same. As is typical, exclusion restrictions are not easy to find. In this case, one can argue for certain exclusions based on the differences between students and their parents. First, since it is parents and not students who choose schools, $z$ can include characteristics specific to the student's parents (mother's education), but exclude characteristics specific to the student (student's sex). Second, the $x$ variables reflect the intrinsic utility of sexual activity, which presumably is formed mostly by genetic and home factors as opposed to school policies. This is especially true of the policies of high schools, which could only have an affect after the student is a teenager. Policies will affect the choice of school by parents, however. Therefore it is reasonable to assume that school policies are present in the $z$ vector but not the $x$ vector. In general, the pattern of results presented below was not sensitive the exclusion assumptions.

## IV. Data

Data come from the National Longitudinal Study of Adolescent Health, or "Add Health" (Udry 1998). In 1994, a representative national sample of about 20,000 students in 130 U.S. schools were asked a battery of questions about their health, their attitudes, and their behavior. The Add Health study then links these responses to information about the students' parents, their friends, their school, and their neighborhood. (A followup survey gives the data a longitudinal perspective. The results here are based on the first-wave cross-section only.) After deleting observations with missing values in certain key variables, and making reasonable imputations of other variables, 18,814 students remained for the main analysis.[16] The teens range from Grade 7 to Grade 12; about one-quarter are nonwhite; 70 percent are in high schools; 85 percent are in public schools. The average school size is about 1,500 teens, in a skewed range from 50 to 5,000. Weights make the sample representative of the U.S. national population of 7–12th grade students. No data are available for students who have dropped out. The effect of this attrition on a study of sexual activity is likely to be minor, however; while 11 percent of 15–19 year olds become pregnant each year, only 55 percent of them give birth, and 70 percent of these teen mothers do complete high school (Alan Guttmacher Institute 1999). Because of the sampling frame, at least 20 observations are obtained from each school in the sample, so good estimates of school-level variables can be made by aggregating student responses by school.

The dependent variable in the sexual activity version of the model is a binary indicator of whether the respondent teen has engaged in sexual activity at any time in the past year. Thus, this study is not directly comparable to studies of the timing of first intercourse (Oettinger 1999). Instead the focus is on the idea that sexual activity may be started or stopped, and that stigma is more likely to be applied for ongoing activity than for having engaged in the activity at any time. Also, studies on the question of whether a teen has ever had sex may be distorted by the fact that a substantial amount of early sexual activity may be involuntary or incestual. Activity in the past year is less likely to be affected by these influences, if only because individual control over the sexual advances of others rises with age.

The data appear to be quite reliable, as the designers of the study have gone to great lengths to avoid biases related to confidentiality issues and respondents' reluctance to be forthcoming about their behavior. Sensitive questions were not asked face-to-face, for example. Instead, recorded interviewing techniques were used, and these were backed up by indirect questioning methods.[17] These methods yield a reasonable rate of current sexual activity among the teens in the sample, about 30 percent.

Independent variables consist of a variety of individual, parental, neighborhood, and school-level measures.[18] The Add-Health data have an impressive array of these variables, including hundreds of contextual variables built by linking the student's home location to data on the census block, census tract, county, and state. Add-Health

16. A significant number of observations had missing values. In some cases, these were simply dropped. In other cases, it seemed more reasonable to impute values using other information at hand. This is the case for household income, which is obviously important, yet which is relatively reliably imputable given the extensive economic information available on the household. A Heckman selection procedure was used; output is available from the author on request.

17. For example, respondents were given a series of cards indicating the events that might have occurred in their last romantic relationship, from holding hands to having sex. The respondent was asked simply to remove from deck the events that did not happen.

18. One notable absence among the independent variables is race. The model would not converge when race, regional variables, and rural/urban were included together, presumably because of the strong correlations between these variables. In essence this means that it is not possible with these methods to identify the effect of race separately from the effect of region and urbanicity. When included by itself, a race variable does not provide much information. Region and urbanicity variables do show important patterns, however, so their results have been presented in the paper.

interviews school administrators to obtain direct data on school conditions and policies, and it interviews parents (usually the mother or mother-figure) to obtain direct data on conditions at home. Finally, the data contain sibling identifiers, so that it is possible to link one teen with his or her brother or sister in the same data set. Thus it is possible to put sibling behavior into the analysis.

Descriptive statistics and definitions for all the variables are presented in Table 1. Roughly, they can be grouped into several categories. The first group is the student's individual characteristics (age, sex, and so on) which will enter the sexual activity equation but not the equilibrium selection equation. The second is parental, home, and neighborhood characteristics (income, mother's education, tract median income, etc.) which enter both equations. A third group is the set of school policy variables (dress code, teacher quality) which enter the equilibrium equation but not the sexual activity choice equation. One could make arguments that some student characteristics would affect parents' choice of school, or that some school policies might affect students' intrinsic motivation; however it is necessary to make some exclusion restrictions in order for the model to be identified. (As noted above, altering the set of exclusions did not have a substantive impact on the results.) Of course there are many variables which might have been included in various equations, and indeed a very large number have been considered in the test runs of the model. Suffice it to say that the variables included here represent the theoretically important factors (age, family structure, economic status, and so on), while also reflecting the patterns that were robust across many different specifications that were tried.[19]

The model was run from many different starting points and the results with highest likelihood are presented below. In any case there was little substantive difference between the different starting point results.[20] In all the estimations, standard errors are calculated using the Huber-White robust method, with clustering by school to account for the possible serial correlation in disturbance terms for teens from the same school. The amount of information in a sample of 19,000 respondents in 130 groups is less than it would be in a sample of 19,000 independent respondents; as a result, standard errors will be higher than one might expect with a sample size of 19,000.

19. Test versions of the model made use of many more variables, but these considerably slowed down the conversion rate without adding much substance to the results. Adding detail about parental education or neighborhood quality, for example, seemed to have very little payoff in terms of information, and a negative effect in terms of model problems and expositional clutter. Therefore, the paper presents results for a large but reasonably limited parameter set. Specifically, every variable that showed itself to have significant effects in different trials either has been included here, or is represented by a similar variable that accounts for the effect (such as mother's education as a general measure for education).

20. The likelihood function for a single observation involves calculating the bivariate normal CDF in two cases, and then summing. The first case calculates the CDF using Equation 4 and Equation 6, the second uses Equation 5 and Equation 6. The two cases represent the permissive and punitive equilibria, respectively. Logs of the two probabilities are then summed, since they are mutually exclusive. If there were only one case, the likelihood function would be essentially based on a simple bivariate normal, and, like the binary probit, it would have global maximum. However, while I have no proof, this model's summation of two CDFs does not seem to have a global maximum: the model does converge to slightly different maxima depending on starting values. As a further test of the practical usefulness of the model, it was applied to smoking behavior, with substantively similar technical results.

**Table 1**
*Variable Definitions and Descriptive Statistics*

| Variable | Definition | Mean | Standard Deviation |
|---|---|---|---|
| SexNow | 1 if R is currently sexually active (dependent variable) | 0.2971 | 0.4570 |
| Income | Household income per equivalent person, divided by 10,000. Income = $(y/n^{1/2})/10000$, where $y$ is total household income and $n$ is size of household. | 0.0193 | 0.0207 |
| Age | Age in months/1000 | 0.1913 | 0.0215 |
| Female | 1 if *R* is female | 0.4914 | — |
| BMI | Body Mass Index/100. BMI is weight in kilograms over height in meters squared | 0.1244 | 0.0452 |
| SibSex | 1 if *R* has a sibling who is sexually active | 0.0886 | — |
| College | 1 if *R*'s mother has a college degree | 0.2111 | — |
| HS | 1 if *R*'s mother has a high school degree | 0.7049 | — |
| ManAtHome | 1 if *R*'s household includes at least one mature male | 0.7479 | — |
| Dinner | Number of times per week that *R* eats dinner with a parent-figure, divided by 10 | 0.4742 | 0.2456 |
| Religious | 1 if *R*'s mother attends religious services once a week or more | 0.3172 | — |
| Nonwhite | 1 if *R* is nonwhite | 0.2548 | — |
| Move | Neighborhood satisfaction: 1 if *R*'s mother would like to leave the neighborhood | 0.1406 | — |
| TractInc | Median household income in *R*'s census tract, divided by 1,000,000 | 0.0289 | 0.0118 |
| Urban | 1 if *R*'s school is in an urban area | 0.2533 | — |
| Rural | 1 if *R*'s school is in a rural area | 0.1870 | — |
| South | 1 if *R*'s school is in the south | 0.3774 | — |
| Size (N) | Size of *R*'s school, divided by 10000 | 0.1537 | 0.0978 |
| ViolRate (v) | Violation rate: Percent of *R*'s school that is sexually active | 0.2971 | 0.1692 |
| Private | 1 if *R*'s school is any school other than a public (state) school | 0.1537 | — |
| TeacherQual | Teacher quality: Percent of teachers in *R*'s school who have a Master's degree or more | 0.4914 | 0.2491 |
| Punish | 1 if *R*'s school imposes suspension on first or second instance of verbal abuse of a teacher | 0.7978 | — |
| DressCode | 1 if *R*'s school has a dress code policy | 0.8649 | — |
| FamPlan | Family planning: 1 if *R*'s school offer family planning services or referrals | 0.5807 | — |

Source: Add-Health Survey. $N$ = 19,459. *R* stands for respondent.

## V. Results

### A. Overview

The coefficient results of the estimation are first presented in Tables 2 and 3. Table 2 gives simple probit and logit regressions of sexual activity on characteristics, replicating the reduced form approach of the literature. Table 3 presents structural estimates. In Table 4, the structural estimates are used to simulate the impact of changing independent variables on the probability of sexual activity. Finally, Table 5 compares the average characteristics of schools in punitive and permissive equilibria.

The findings suggest that stigma does exist, in the sense that there are schools in which the behaviors observed seem to stem from a punitive equilibrium rather than a permissive equilibrium. Where the punitive equilibrium is in effect, stigma seems to be neither trivial nor decisive. However, the results also suggest that the punitive equilibrium is not universal, and that the aggregate response of sexual activity to school average rates is not very large. Thus, as argued in the introduction, while the aggregate responsiveness of behavior to norms seems weak, the data do not reject a norm-based theory.

Of all factors, the family seems to have the strongest influence on teen sexual activity.

The model fits well. The structural model generates an average predicted probability of sexual activity of 0.29, virtually indistinguishable from the actual sample frequency. These coefficients correctly predict 57 percent of successes ($s = 1$) and 78 percent of failures ($s = 0$).

### B. Coefficients

Table 2 presents coefficients from simple binary-choice models of teen sexual activity. This is roughly what one would do if one were to assume that all schools are in punitive equilibria. I include models with and without *FamPlan* (which equals one if the school offers family planning counseling and referral) because, as will be seen, it is a problematic variable in the structural modeling. The regressions reveal that, in these data, most of the more intuitive effects on teen sexual activity are indeed present. Sexual activity rises if the teen's sibling is sexually active, for example.

These models are perhaps more instructive in revealing what one cannot learn from them, however. If the question is "Do social norms affect behavior?" these regressions are not very informative. At best, one might infer from the magnitude of the coefficients on $Nv$ and $N(1\text{-}v)$, which estimate $\theta$ and $\varphi$ respectively, something about the size of stigma costs. Beyond this, the regressions say little about social norms. In particular, they do not directly test for the prevalence of the punitive equilibrium in the data, and they offer no means for assessing whether a student who is moved from a punitive school to a permissive one acts differently, ceteris paribus. Yet this is the only thought exercise that can answer the question of whether norms affect behavior.

The reduced form regressions do, however, reveal some interesting and fairly robust patterns in the data. Specifically they suggest that, all else equal, the teen's gender and family income do not have a statistically significant effect on sexual activity.

**Table 2**
*Reduced-Form Estimates of Sexual Activity in High Schools. Dependent Variable = 1 if Student is Sexually Active. Standard Errors Under Coefficients*

| | Probit | | Logit | |
|---|---|---|---|---|
| Income | 1.112 | 1.107 | 1.867 | 1.858 |
| | 0.777 | 0.780 | 1.278 | 1.283 |
| Age | 20.278 | 20.282 | 34.621 | 34.630 |
| | *1.545 | *1.542 | *2.671 | 2.667 |
| Female | 0.063 | 0.063 | 0.114 | 0.114 |
| | 0.042 | 0.042 | 0.073 | 0.073 |
| BMI | –0.860 | –0.859 | –1.510 | –1.509 |
| | *0.466 | *0.467 | *0.812 | 0.813 |
| SibSex | 0.169 | 0.168 | 0.289 | 0.288 |
| | *0.058 | *0.057 | *0.099 | 0.098 |
| FamPlan | 0.016 | — | 0.027 | — |
| | 0.046 | | 0.078 | |
| College | –0.182 | –0.183 | –0.293 | –0.294 |
| | *0.051 | *0.051 | *0.089 | 0.089 |
| HS | –0.026 | –0.026 | –0.045 | –0.044 |
| | 0.042 | 0.042 | 0.070 | 0.070 |
| ManAtHome | –0.274 | –0.275 | –0.463 | –0.464 |
| | *0.037 | *0.038 | *0.064 | 0.065 |
| Dinner | –0.661 | –0.661 | –1.115 | –1.115 |
| | *0.083 | *0.083 | *0.144 | 0.144 |
| Religious | –0.236 | –0.236 | –0.410 | –0.411 |
| | *0.044 | *0.044 | *0.076 | 0.076 |
| Nonwhite | –0.005 | –0.005 | –0.029 | –0.029 |
| | 0.045 | 0.045 | 0.078 | 0.078 |
| TractInc | –3.409 | –3.365 | –5.633 | –5.556 |
| | *0.045 | *1.722 | *2.972 | 2.933 |
| Urban | –0.105 | –0.106 | –0.183 | –0.185 |
| | *0.054 | *0.053 | *0.094 | 0.092 |
| Rural | –0.026 | –0.020 | –0.033 | –0.023 |
| | 0.056 | 0.054 | 0.093 | 0.089 |
| South | 0.118 | 0.115 | 0.197 | 0.193 |
| | *0.044 | *0.044 | *0.075 | 0.074 |
| N*v | 5.812 | 5.848 | 9.917 | 9.972 |
| | *0.614 | *0.581 | *1.063 | 1.011 |
| N*(1-v) | 3.073 | 3.064 | 5.322 | 5.304 |
| | *0.311 | *0.315 | *0.538 | 0.547 |
| Constant | –3.754 | –3.749 | –6.391 | –6.383 |
| | *0.311 | *0.308 | *0.540 | 0.535 |
| Log likelihood | –9,381.69 | –9,381.93 | –9,396.79 | –9,397.02 |

Source: Add-Health Survey. $N$ = 18,814. * indicates statistical significance at the 10 percent level, two-tailed test.

**Table 3**
*Structural Estimates of Sexual Activity in High Schools. Standard Errors Under Coefficients*

| Independent Variables | Specification 1: Dependent: Sexual Activity = 1 | Specification 1: Dependent: Punitive Equilibrium = 1 | Specification 2: Dependent: Sexual Activity = 1 | Specification 2: Dependent: Punitive Equilibrium = 1 |
|---|---|---|---|---|
| Income | 0.476 | 2.195 | 1.300 | –129.629 |
| | 0.632 | *1.021 | *0.587 | *19.081 |
| Age | 15.075 | — | 21.977 | — |
| | *1.397 | | *0.779 | |
| Female | 0.041 | — | 0.064 | — |
| | *0.021 | | *0.027 | |
| BMI | –0.611 | — | –0.890 | — |
| | *0.241 | | *0.306 | |
| SibSex | 0.111 | — | 0.153 | — |
| | *0.035 | | *0.045 | |
| FamPlan | — | –0.138 | 0.026 | –9.222 |
| | | 0.089 | 0.029 | *1.352 |
| College | –0.122 | –0.084 | –0.166 | –11.090 |
| | *0.032 | 0.176 | *0.037 | *1.554 |
| HS | –0.026 | 0.328 | –0.033 | –20.370 |
| | 0.066 | *0.110 | 0.035 | *3.047 |
| ManAtHome | –0.195 | –0.119 | –0.268 | –11.069 |
| | *0.033 | 0.247 | *0.033 | *1.544 |
| Dinner | –0.482 | 0.215 | –0.701 | 23.073 |
| | *0.065 | 0.298 | *0.056 | *3.466 |
| Religious | –0.161 | –0.082 | –0.237 | 23.134 |
| | *0.034 | 0.082 | *0.032 | *3.308 |
| Nonwhite | –0.043 | 0.354 | 0.005 | 2.015 |
| | 0.058 | *0.099 | 0.032 | *0.397 |
| TractInc | –4.272 | 10.713 | –3.666 | 27.038 |
| | 2.725 | *5.137 | *1.134 | *12.164 |
| Urban | –0.880 | 2.277 | –0.077 | –3.825 |
| | *0.106 | *0.931 | *0.034 | *0.544 |
| Rural | –0.106 | 0.566 | –0.048 | 7.387 |
| | 0.110 | *0.139 | 0.039 | *1.196 |
| South | 0.079 | 0.194 | 0.152 | –11.428 |
| | *0.042 | 0.191 | *0.031 | *1.737 |
| *N***v* | 6.589 | — | 6.345 | — |
| | *1.153 | | *0.492 | |
| *N**(1-*v*) | 3.050 | — | 3.300 | — |
| | *0.428 | | *0.319 | |
| Move | — | –.334 | — | –24.071 |
| | | .239 | | *3.468 |
| Private | — | –0.413 | — | 33.604 |
| | | *0.139 | | *4.994 |

**Table 3** (*continued*)

| Independent Variables | Specification 1 Dependent: Sexual Activity = 1 | Specification 1 Dependent: Punitive Equilibrium = 1 | Specification 2 Dependent: Sexual Activity = 1 | Specification 2 Dependent: Punitive Equilibrium = 1 |
|---|---|---|---|---|
| TeacherQual | — | –0.021 | — | 61.752 |
| | | 0.192 | | *8.878 |
| Punish | — | 0.076 | — | 19.215 |
| | | 0.104 | | *2.840 |
| DressCode | — | –0.122 | — | 22.645 |
| | | 0.429 | | *3.284 |
| ρ | — | –0.9236 | — | 0.9986 |
| | | *0.0371 | | *0.0048 |
| Constant | –2.032 | –0.581 | –4.125 | –42.794 |
| | *0.304 | *0.338 | 0.164 | *6.354 |
| Correct prediction of dependent variable = 1 | 57% | 87% | 57% | 78% |
| Log likelihood | –9,268.47 | | –9,307.77 | |
| Iterations | 15 | | 34 | |

Source: Add-Health Survey. $N$ = 18,814. * indicates statistical significance at the 10 percent level, two-tailed test.

If anything, girls seem to be more likely than boys to be sexually active, and richer students more likely than poorer ones. Both results are somewhat surprising. One can only conclude that the intuitions must have derived from the correlation of these variables with other variables, specifically the family variables that will appear, throughout these results, to be so much more important.

Table 3 presents results from the structural model in Equations 4 and 5. Two specifications are presented. In each specification, the first equation has sexual activity as the dependent variable, and the second equation has punitive equilibrium (yes/no) as the dependent variable. The two specifications differ only in that *FamPlan* enters the sexual activity equation in the second specification. There are strong substantive reasons for allowing family planning to have a direct effect on sexual activity, but, as will be seen, there are strong econometric reasons not to include it. The family planning variable is critical from a policy perspective, so both specifications are presented in order to clarify its contribution to the results.[21]

21. The Add-Health Survey contains data on the presence of sex education, but as more than 90 percent of schools report that they have sex education, the information is not very useful. There is much more variation in family planning services (that is, condoms in the schools), so policy attention has been focused there.

**Table 4**
*Simulated Effect of Independent Variables on Sexual Activity. Cell Entries Are Percentage Changes from the Base Case*

| Variable | Probability of Punitive Equilibrium | Probability of Sexual Activity |
|---|---|---|
| Base case[a] | 49 | 21 |
| Permissive instead of punitive equilibrium | n/a | –5 |
| School violation rate + 10% | b | 6 |
| Income +10% | 0 | 0 |
| Age + 1 year | b | 26 |
| Female to male | b | –5 |
| BMI + 10% | b | –1 |
| *SibSex*: N to Y | b | 16 |
| *College* Y, *HS* Y to *College* N, *HS* N | –19 | 21 |
| *ManAtHome*: Y to N | 10 | 28 |
| *Dinner*: + 1 night | 2 | –6 |
| *Nonwhite*: N to Y | 28 | –6 |
| Base case[a] | 49 | 21 |
| *Religious*: N to Y | –7 | –20 |
| *Move*: N to Y | –26 | b |
| *TractInc* + 10% | 2 | –2 |
| *Private*: N to Y | –32 | b |
| *TeacherQual* + 10% | 0 | b |
| *Punish*: N to Y | 6 | b |
| *DressCode*: N to Y | –10 | b |
| *FamilyPlan*: N to Y | –11 | b |
| $\theta$ + 10% | b | –4 |
| $\varphi$ + 10% | b | 4 |

Source: Author's calculations from Add-Health Survey, using results in Table 3.
a. Base case is for a 13-year-old student in a punitive equilibrium. All continuous variables are at their sample means and discrete variables have the following values: *Female* = 1, *SibSex* = 0, *College* = 1, *HS* = 1, *ManAtHome* = 1, *Religious* = 0, *Neighborhood* = 0, *Urban* = 0, *Rural* = 0, *South* = 0, *Private* = 0, *Punish* = 0, *DressCode* = 0, *FamilyPlan* = 0.
b. Variable not included in the equation.

First, consider Specification 1. The coefficients on $Nv$ and $N(1\text{-}v)$ indicate that the per-encounter cost of imposing stigma ($\theta = 6.6$) is about twice as large as the per-encounter cost of receiving stigma ($\varphi = 3.1$). The fact that these coefficients are statistically significant makes it more than likely that stigma does exist within punitive equilibria, and that it imposes real utility costs on both the stigmatizers and the stigmatized. The substantive significance of the stigma parameters has to be assessed by taking account of average school sizes and violation rates; this will be done in Table 4 below.

**Table 5**
*Characteristics of Permissive and Punitive Schools*

| Characteristic | Sample Mean in Permissive Equilibria N = 5,355 | Sample Mean in Punitive Equilibria N = 14,104 |
|---|---|---|
| R: Sex now? | 0.31 | 0.29 |
| Sex: Female | 0.49 | 0.49 |
| Age (months) | 191 | 192 |
| Standardized Test Score (range 0.13 – 1.46) | 1.03 | 1.00 |
| R: Weekly Religious Attendance | 0.34 | 0.38 |
| R ever smoked pot? | 0.17 | 0.13 |
| R ever shoplifted? | 0.24 | 0.22 |
| R's household equivalent income | 20,716 | 18,782 |
| Mom has HS degree | 0.73 | 0.69 |
| Mom has college degree | 0.24 | 0.20 |
| Mom wants to leave neighborhood | 0.14 | 0.14 |
| Man at home | 0.77 | 0.74 |
| R's mom married? | 0.66 | 0.61 |
| Median household income in R's tract | 29,191 | 28,819 |
| R lives in Northeast | 0.16 | 0.12 |
| R lives in South | 0.21 | 0.44 |
| R lives in Midwest | 0.50 | 0.26 |
| R lives in west | 0.11 | 0.18 |
| R's area is urban | 0.00 | 0.35 |
| R's area is suburban | 0.97 | 0.40 |
| R's area is rural | 0.00 | 0.25 |
| Poverty rate in R's census tract | 0.13 | 0.16 |
| Size of R's school | 1,269 | 1,639 |
| Percent of R's teachers with MS degree | 0.53 | 0.48 |
| R's school is private | 0.24 | 0.12 |
| R's school quickly punishes abuse of teachers | 0.60 | 0.87 |
| R's school quickly punishes cheating | 0.11 | 0.19 |
| R's school has dress code | 0.91 | 0.85 |
| R's school offer family planning services | 0.60 | 0.57 |

Source: Author's calculations from the Add-Health Survey and Table 3. The school equilibrium is considered punitive if the majority of the school's students have a greater than 50 percent estimated probability of being in a punitive equilibrium.

In the sexual activity equation, most of the other coefficients have intuitive signs as in the reduced-form regressions. Age is positive and statistically significant. (The substantive significance of the coefficients will be analyzed below.) Other factors that increase sexual activity include being female, having a sexually active sibling, and living in the South. Factors which reduce sexual activity include the BMI, mother's education, having an adult male at home, having dinner with parents, and having a religious mother.

The second column presents the coefficients of the equilibrium selection equation. If one uses this equation to predict equilibria, it turns out that about 68.2 percent of students are in punitive equilibria. Thus, these equilbria do not seem to be universal as has been commonly assumed in the previous empirical literature. In the various versions of the model that have been tested, the fraction of punitive equilibria only rarely came in above 85 percent or below 50 percent. The finding that only something more than one-half of schools actually have punitive equilibria regarding sexual activity seems to be fairly robust. The rest of the schools are in permissive equilibria, in which there is no stigma at all.

The coefficients suggest that the factors that increase the likelihood of selection into punitive equilibrium include: income, neighborhood income, mother's high school completion but not college, being nonwhite, and being urban or rural as opposed to suburban. Factors which decrease the likelihood of punitive equilibria include the school being private. The correlation of errors in strongly negative ($\rho = -0.92$), which is intuitive: parents who are more likely to choose punitive equilibria for unobservable reasons are less likely to have children whose unobservable characteristics spur them to greater sexual activity.

Specification 2 repeats Specification 1, but includes family planning in the school as a direct effect on sexual activity. In that equation, the coefficient is positive but not statistically significant (as in the reduced-form regressions in Table 2). In the equilibrium selection equation, family planning has a negative and statistically significant effect on the probability of punitive equilibrium. Based on these results alone, one might conclude that family planning has the effect that many have claimed: it has a direct positive effect on sexual activity, and even if that effect is weak, it has a strongly negative effect on the formation of norms against sex in the school.

On deeper (and repeated) examination, however, the data seem to reject that interpretation, because Specification 2 fits these data poorly relative to Specification 1. The poor fit manifests itself in a number of ways. Specification 2 converges less rapidly than Specification 1; it crashes more often; it produces an unrealistic and unintuitive estimate of $\rho$ (positive and equal to 0.9986); it predicts the dependent variable with less success; its coefficients tend to be unrealistically large and unintuitively statistically significant; its log likelihood is lower. Specification 2 is apparently not well behaved. For this reason, I have chosen to focus attention on Specification 1. In terms of substance, of course, a focus on Specification 1 makes little difference, since the coefficient on family planning in the sexual activity equation is small in any case. Nonetheless, it is worthwhile to present both specifications in order to clarify the role of family planning. Namely, it seems that it is not correct to conclude that family planning has a strong direct effect on teen sexual activity. Moreover, there is no strong evidence that it indirectly affects behavior through norms. Overall, these two specifications suggest that there is no strong evidence that family planning is a particularly important determinant of teen sexual activity.

### C. Simulations

The relative unimportance of school-based family planning will become clearer as we examine factors that *do* have a significant influence. This is done in Table 4, which will be based on coefficients from Specification 1 because of its comparatively better fit to the data. The analysis begins with a base case, constructed by assigning values to all the independent variables and assuming a punitive equilibrium. The base case is a 13-year-old girl at a suburban, public, school, outside the south, whose mother has a high school and college degree, does not attend religious services weekly, and does not want to move out of the neighborhood. The girl does not have a sexually active sibling but does have an older male living in the home. The girl's school does not immediately punish verbal abuse of a teacher, does not have a dress code, and does not have on-site family planning services. Other than these discrete categories the girl has an average income and Body Mass Index; she eats dinner with a parent an average number of nights per week; and her school has an average percentage of teachers with master's degrees.

With these base-case variables, the model predicts that the probability of a punitive equilibrium is 49 percent, and the probability of sexual activity is 21 percent. If the school equilibrium is switched to the permissive equilibrium but all other factors are held constant, the probability of sexual activity falls by 5 percent.[22] If the girl becomes 14 years old instead of 13, her probability of sexual activity rises by 26 percent. Other substantively important influences include having a sexually active sibling, a male role model at home, having dinner with parents, mother's education, and mother's religiosity. Income, which has statistically significant coefficients in several equations, is shown here to have no substantive effect on behavior; the coefficients are statistically significant but substantively small.

The stigma parameters reveal that a 10 percent increase in the cost of imposing stigma, or a 10 percent decrease in the cost of receiving stigma, both have an equally large effect on the probability of sexual activity, +4 percent. This means that after accounting for school sizes and violation rates, changes in the cost of imposing stigma and having it imposed have the same elasticity impact on behavior, about 0.4. Of course, it is possible that the identifying variables, $Nv$ and $N(1\text{-}v)$ are merely picking up the impact of some unobserved variable; we cannot identify whether it is norms or some other factor that makes students respond in this way to their peers. However, a response elasticity in this magnitude is at least consistent with a theory that norms do influence behavior.

In terms of the equilibrium selection equation, it seems that few school characteristics have solid impacts on the nature of the local equilibrium. Private schools and schools with dress codes and family planning seem less likely to have punitive equilibria, but these results are based on statistically insignificant coefficients and have to be taken with a grain of salt.

In general, the simulations show teen sexual activity is determined largely by age and family factors, only somewhat by social stigma, and not at all by income.

22. Please note that this is a percent change, not a percentage point change.

### *D. Characteristics of Permissive and Punitive Schools*

With the coefficients in Table 3 it is possible to predict for each student the likelihood of being in a punitive or permissive equilibrium. Because the students are clustered by school, one can use these predictions to make a prediction about the equilibrium that is probably in force in the schools. In order to keep things simple, consider the sensible (but ad hoc) rule that a school is likely to be in a punitive equilibrium if and only if its students seem to act as if *they* are in a punitive equilibrium. Specifically, a school is considered "punitive" if the majority of its students have a greater than 50 percent probability of being in a punitive equilibrium.[23] By this criterion, 72 percent of the students are in punitive schools. Table 5 compares the characteristics of punitive schools to those of permissive schools. Many characteristics have been examined, but most of those that showed very small differences have not been included in the table. Obviously the differences are descriptive, not causal; but they are interesting in that they provide a rare glimpse of the conditions under which different social norm equilibria—which heretofore have not been observed as such—tend to emerge.

The table shows that students in permissive schools have sex with somewhat more frequency than students in punitive schools. The difference (29 versus 31 percent, a difference of about 7 percent) is, again, something that is neither trivial nor inconsequential. Considering other variables, there is little difference in the sex, age, or intelligence of students at the two kinds of schools. Their rate of delinquency seems about the same, and school policies seem about the same. The main differences are that permissive schools tend to have wealthier students, from wealthier areas, with better-educated parents. Their families tend to be more stable, with more having a man in the home and a married mother. Lastly, the permissive schools tend to be concentrated in the suburban Midwest, a region with a reputation for progressive policies, civil peace, personal safety, and high quality of life. Overall, these patterns (and the table coefficients) suggest that high income leads people to rely less on norms systems to regulate the behavior of others. Also, strength in other social institutions (family structure, neighborhood quality) is associated with less reliance on norms. In other words, it appears that social capital is negatively related to socioeconomic status, not positively related as most social capital theorists assume.

## VI. Summary

In the simple model of social norms presented in the theory section of the paper, a shift from permissive to punitive equilibrium lowers the well-being of all the students. Some students lose because they would have engaged in activity that they desired, but they are now prevented from doing that by the threat of stigma. Others lose because they will be engaging in the activity regardless of the equilibrium, but in the punitive equilibrium they are stigmatized. Still others lose because, although they do not engage in stigmatized activity in either equilibrium, in the puni-

23. A proper assignment of schools into equilibria would have to take account of the fact that each student's individual likelihood of being in an equilibrium depends on whether the school is, in fact, in that equilibrium or not. Making the assignment this way would be complex but possible; it is not clear that the assignment would be radically different from the essentially ad hoc assignment done here.

tive equilibrium they bear the cost of imposing stigma on other students. These three groups constitute the entire student population. It seems clear that, on a conceptual level, social norms are an expensive institution. Those responsible for inducing different equilibria—for redefining culture—should weigh the real benefits of behavioral change against the real costs of social conformity. Considering these potentially important effects of norm management on social welfare, this paper has had two empirical objectives: To provide a better test of the theory that society influences individual decisions through norms, and to shed some light on the relationship between policies and behavior when norms are in effect.

On the first issue, the results are fairly clear: Society does seem to have some effect on behavior through norm systems. Having described a norm system using a formal theory, it has been possible to provide evidence that the behavior of U.S. teenagers responds to social forces in a way that is consistent with that theory. In about 70 percent of U.S. schools, teens do respond to the behavior of other teens. In the remaining 30 percent, they do not. Reduced-form regressions, which assume that all schools are punitive, revealed that there does seem to be some responsiveness of sexual activity to stigma, but any such response is unidentified because the model is misspecified. A structural model is needed to correctly specify the multiple-equilibrium structure, and such a model reveals that the elasticity of sexual activity with respect to stigma costs is about 0.4 and has the correct signs. The model reveals further that switching a student from a punitive to a permissive equilibrium increases the rate of sexual activity by 5 percent. While it is always possible that the results may be driven by unobservable variables, norm effects in such magnitudes are at least consistent with theories that norms are neither trivial nor decisive.

On the second issue, the results suggest that some common assumptions about the function of social norms may need to be reviewed. It is generally assumed, for example, that the poor have weaker norms than the middle class. On the contrary, social norms seem to be less likely as income rises. Moreover, there is no strong evidence here for the view that school family-planning services have a strong effect on teen sexual activity. The most permissive schools seem to be in well-off neighborhoods in the suburban Midwest, not in the urban core.

If anything, this attempt to provide a better test of the influence of norms and policies, both of which occur in the school, has mostly shown how relatively unimportant the school and social environment is relative to the home environment. The simulations suggest that a 13-year-old girl who lives with her mother only and has dinner at home twice a week has a probability of sexual activity of 32.1 percent. If she eats dinner with her mom and dad every night, the probability is cut to 18.4 percent.

## Appendix

### *Existence of Equilibria*

Here we show that the *Punitive* and *Permissive* equilibria defined in the text are Nash equilibria. Agents choose whether to be sexually active ($s_i = 1$ or 0) and whether to be punitive ($p_i = 1$ or 0). Punitive agents impose stigma on all sexually active and all non-punitive agents. The cost of imposing stigma is $\theta$ and the cost of receiving stigma is

$\varphi$. There are $N + 1$ agents in the population. In each period, each agent meets with the other $N$ agents, a fraction $\pi$ of whom are punitive and a fraction $v$ sexually active. Agent $i$ maximizes $W(s, p)$:

$$(A1)\quad W(s_i, p_i) = u(y_i - cs_i) + \varepsilon_i s_i - \pi N (\varphi s_i + \varphi((1 - p_i) - s_i (1 - p_i))) - (1 - \pi + v\pi)N\theta p_i$$

Consider the following four strategies:
1: $s_i = 0$, $p_i = 1$ Sexually inactive and punitive
2: $s_i = 0$, $p_i = 0$ Sexually inactive and permissive
3: $s_i = 1$, $p_i = 0$ Sexually active and permissive
4: $s_i = 1$, $p_{ii} = 1$ Sexually active and punitive

Let the symbols $x_j$, $j = 1, 2, 3, 4$, represent the fraction of the population that takes the indicated pair of activity/punishment choices, with $\Sigma_j^{x_j} = 1$.

Under Assumptions 1 and 2 in the text, Strategy 4 is eliminated by strict dominance, and no equilibrium can involve $x_1 = 1$, $x_2 = 1$, $x_3 = 0$, or $x_3 = 1$. There are at least two strategy mixes that might be equilibria, however.

A. $x_1 = 0$:
$p_i = 0$, all $i$
$s_i = 1$ *iff* $\varepsilon_i < u(y_i) - u(y_i - c)$, zero otherwise

No agents punish, while some are sexually active and others are not. The population sexual activity rate is $v = \Sigma_i \; I[\varepsilon_i > u(y_i) - u(y_i - c)]/N$ and the punishment rate is $\pi = 0$. Given these rates, punishment is a dominated strategy. With $\pi = 0$, adopting the punishment strategy imposes a cost of $N\theta$, whereas adopting a no-punishment strategy has no effect on utility at all—again because if $\pi = 0$, there is no stigma from failing to punish. Therefore it is individually optimal not to punish; and given that no one punishes, it is individually optimal for the high-$\varepsilon$ types to be sexually active and the low-$\varepsilon$ types to be inactive according to the criteria just given. This will be referred to as the *Permissive Equilibrium.*

B. $x_2 = 0$:

$\pi\varphi > v\theta$

$p_i = 1 - s_i$

$s_i = 1$ *iff* $\varepsilon_i > u(y_i) - u(y_i - c) + \pi N\varphi - vN\theta$, zero otherwise

Some agents are sexually active. Others are not sexually inactive, and they adopt the punishment strategy. It follows that $v + \pi = 1$. Because the utility of violating the norm will depend on the frequency of violation, $v$ is a function of itself:

$$(A2)\quad v = \frac{1}{N}\sum_i I[\varepsilon_i > u(y_i) - u(y_i - c) + N((1 - v)\varphi - v\theta]$$

The existence of equilibria depend on the existence of fixed points in Equation A2. With $\varphi$ and $\theta$ positive, the RHS of A2 is upward sloping in $v$. Assumptions 1 and 2 state that there will always be some sexually active students, as well as some sexually inactive students, even if punishment is universal or nonexistent, respectively. As a result, we have that $v(0) > 0$: even if it is expected that no agents will be sexually active, and therefore that all agents are punishing, there will still be some who choose to be sexually active. By similar reasoning, we have $v(1) < 1$. It follows that that there exists at least one fixed point to A2.

If no one who is sexually inactive punishes, and if everyone who is active does not, then the decision rules for sexual activity given above are individually optimal. Since we have already ruled out strategies where agents are sexually active yet punish, equilibrium only depends on whether punishment is indeed optimal for all sexually inactive agents. This will be the case if $\pi\varphi > v\theta$: if the stigma cost of failing to punish others exceeds the cost of imposing the punishment, the punishment strategy is optimal. When this condition is met, the equilibrium involves having all sexually inactive students engage in punishment. This is the equilibrium used in the text as the *Punitive Equilibrium.*

What if the condition is not met? If $\pi\varphi < v\theta$, then, at the candidate equilibrium values of $\pi$ and $v$, no one has the incentive to impose punishment. Hence, punishment cannot be sustained as equilibrium behavior. In effect, the parameters, in this case, ensure that only the permissive equilibrium is possible.

If $\pi\varphi = v\theta$, then all nonactive students are indifferent to punishment. A two-equation fixed-point system in $\pi$ and $v$ would be necessary to prove the existence of equilibrium in that case. However, the knife-edge nature of this condition makes it reasonable to assume, for empirical purposes anyway, that such situations are rare enough to be ignored in the econometric work. Assumption 3 rules out this case, by assuming that all sexually inactive students will choose to punish, even if $\pi\varphi = v\theta$.

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