Peer Effects and Early Sexual Initiation for African-Americans Adolescents*

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Abstract

Adolescent risky sexual behavior is serious problem that plagues the African-American population more than other ethnic groups. African-American males are more likely to be sexually active, have multiple partners, and have a higher incidence of sexually-transmitted diseases. This paper explores the role of peer effects on early sexual initiation for African-American youth. Most studies analyzing peer influences ignore the "reflection" problem that occurs with studying peer effects. One method of solving this problem is through the use of spatial econometrics. This study contributes to literature on adolescent risky sexual behavior by using a generalized spatial autoregressive approach to model peer effects. This study is one of the first to incorporate both social networks and neighborhood effects with the spatial model. The results show that peer effects do play a role in the sexual behavior of African-Americans, but this role is dependent on how the peer groups are defined.

1   INTRODUCTION

In 1991, NBA superstar Earvin "Magic" Johnson announced on national television that he had contracted the AIDS virus. This event sent shockwaves throughout the nation and through many different communities. This hit the African-American population especially hard since it was generally thought of as a "gay" disease (Mays and Cochran, 1988). Data from the Youth Risk Behavior Surveillance System showed that risky sexual behavior by African-American youths began a decline in 1991 (CDC, 2008). However, beginning in 2001 this declined stopped. In fact, African-American youth are more likely to engage in risky sexual behavior than any other ethnic group (Forehand et al., 2007). African-American males were 2.8 times more likely, on average, to be sexually active than White adolescents (Zimmer-Gembeck and Helfand, 2007). This is an important policy concern because the HIV prevalence rate and the rate of sexually transmitted diseases (STDs) among African-American youths, especially males, far exceed that of any other ethnic group. In 2007, the HIV prevalence rate for African-American males was 2.5% while the prevalence rate for White males was under 0.5% (CDC, 2008).

Early initiation of sexual behavior is associated with adverse health and educational outcomes such as STDs, unintended pregnancies (Davis and Friel, 2001), poor mental health (Sabia and Rees, 2008) and lower grade-point averages (Sabia, 2007). This is of particular concern for adolescents since risky sexual behavior not only adversely affects outcomes in the short-run but also has important long-run ramifications (Gruber, 2001; O'Donoghue and Rabin, 2001). There is a vast literature that studies the factors that influence adolescent risky sexual behavior (Buhi and Goodson, 2007). These factors include intentions to have sex, environmental constraints, and social norms. Also, an individual's view of their peers' view on sexual behavior plays a significant role (Kinsman et al, 1998). Peers can influence individual behavior through several mechanisms. Individuals can engage in behavior because they believe engaging in this behavior will enhance their popularity, it matches the social norms of a desired group, it is reinforced by peers, or the behavior contributes to a favorable self-identity (Brechwald and Prinstein, 2011). Peers also influence sexual activity through dissemination of information and the formation of intention to engage in sexual activity. Recently has there been a focus on peer effects and the importance

of social networks. The study of peer effects in health behaviors has flourished because of the realization while individuals make choices based on individual preferences, their decisions can be influenced by others (Blume and Durlauf, 2005; Cawley and Ruhm, 2011).

While the main focus is on the peer group being an adolescent's social network, neighborhoods can play a role in sexual activity. The structural conditions of neighborhoods can play a role in the development of attitudes and norms that can influence the behavior of individuals within those neighborhoods (Galster, 2012). Neighborhood effects could pick up the fact that people in a community can encourage or discourage sexual activity. Upchurch et al (1999) find that the social conditions within neighborhoods explain ethnic differences in sexual activity. Browning et al (2004) show that concentrated poverty explains racial differences in early sexual activity. Warner et al (2011) describe how an adolescent's neighborhood environment plays a role in their behavior as well as their social environment. Any study of adolescent sexual activity must include neighborhood effects as well as peer influences.

This paper estimates how an adolescent's peer group affects whether they engage in sexual activity by the age of thirteen, with a particular focus on the African-American population. While the analysis of peer influence on sexual activity is well researched, there are noted methodological issues with the estimation of peer effects (Manski, 1993). Many studies on peer effects do not account for these issues and in the studies that try to correct for these issues, most scholars use either school fixed effects or instrumental variable regression techniques to model the endogenous interactions (Fletcher, 2011). However, recent advances in spatial econometrics have been shown to be useful in estimating social interaction models (Blume et al, 2010). Lee (2007) argues that using spatial analysis brings the model closer to standard social interactions model by explicitly modeling the contextual effects. This methodology has been applied to studies of student achievement (Lin, 2010) and fast food consumption (Fortin & Yazbeck, 2011). The efficacy of this methodology is that it can account for both the social environment and the neighborhood environment. This paper is the first to apply spatial methodology to the estimation of peer effects on adolescent risky sexual behavior. Data is taken from the National Longitudinal Survey of Adolescent Health (Add Health) dataset to estimate the model. I find that peer

effects exist and play a significant role in early sexual initiation for African-Americans, though this effect depends on the definition of the individual's peer group.

2   THE REFLECTION PROBLEM

The theoretical framework for analyzing peer effects come from the social interactions literature. Social interaction models study the relationship between interactions among individuals and collective behavior. Akerlof (1997) explains, "As a consequence, the impact of my choices on my interactions with other members of my social network may be the primary determinant of my decision, with the ordinary determinants of choice of only secondary importance." These models can help explain the observation that individuals within the same group tend to exhibit the same behavior. This explains the popularity of social interaction models for the exploration of peer group effects. Peer groups can influence adolescent decision-making through three mechanisms: endogenous interactions, contextual interactions, and correlated effects (Manski, 2000). Endogenous interactions occur when the behavior of the group affects the behavior of the individual, contextual interactions occur the individual's behavior varies with the characteristics of the group like age, race or gender, and correlated effects occur when the environment plays a role in the behavior of individuals within a group. Several authors have sought to empirically test these interactions and effects, mostly the endogenous interactions (Blume and Durlauf, 2005; Fowler and Christakis, 2008).

A problem with the estimation of social interaction models is the "reflection" problem (Manski, 1993). While peers' outcome affects the individual's decision, the individual's decision could influence the peers' outcome. In the reduced form of the social interaction framework, the endogenous effect and the contextual effects cannot be separated (Durlauf and Ioannides, 2010). The key question in the literature has been how to disentangle these effects and properly identify the model. Soetevent (2006) outlines the problems and the methods to estimate social interaction models. One method is to use data where groups are randomly assigned (Sacerdote, 2001). A recent paper uses regression discontinuity design to study peer effects within a paternity leave program in Norway (Dahl et al, 2012). A third

method is to use experimental data (Potters et al, 2007). A fourth method is the use of instrumental variables, which has been used extensively in the literature (Case and Katz, 1991; Gaviria and Raphael, 2001; Fletcher, 2007; Ali and Dwyer, 2011). However, there are several issues with the existing methods of identifying these models (Fletcher and Ross, 2012).

3   SPATIAL ANALYSIS OF SOCIAL INTERACTION MODELS

Though these methods can address the reflection problem, there are still some limitations with the identification of social interaction models. The application of spatial econometrics using social networks has been shown to be an improvement on identification (Bramoulle, Djebbari, and Fortin, 2009; Lee, 2007; Lee, Liu, and Lin, 2010). Blume et al (2010) argue, "Social network models provide further focus on the microstructure of interactions among agents and allow for heterogeneity of interactions across pairs of agents." Lin (2010) argues that the spatial autoregressive (SAR) model provides enough information to identify the endogenous and contextual effects, thus avoiding the reflection problem. The equation for a SAR model, which takes this impact into account, follows:

(1) $Y = \lambda WY + X\beta + u,$

where y is a function of the neighboring regions' y, and a series of Xs. W represents the spatial weight matrix that quantifies the relationship between the observations. If λ is significantly different from zero, then the data exhibits spatial dependence, indicating that the actions in one region impact those of a neighboring region. There are a variety of methods for specifying the weight matrix W, including using the relationship between observations based on Euclidean distances (a nearest-neighbors matrix) or assigning values of 1 if regions are adjacent and 0 otherwise (first-order contiguity matrix).

In the social interactions literature, W represents a social network weight matrix where individuals who are assigned a 1 if they are in the same peer group and a 0 otherwise. The endogenous peer effect is represented by λ in (1). To fully incorporate all the mechanisms in a social interactions model we outline a generalized version of the Cliff-Ord spatial model that allows for spatial interactions

in the dependent variable, explanatory variables, and the disturbances. The empirical specification is given in (2):

(2) $Y = \alpha i + \lambda WY + X\beta + WX\theta + u,\ u = \rho Mu + \epsilon$

In the social interactions framework, the first term (λWy) is the endogenous peer effect, the spatially lagged explanatory variables ($WX\theta$) are the contextual effects, and the spatial interactions in the disturbances (ρMu) are the correlated effects. While the group fixed effects (αi) represent common environmental factors, there may be correlated effects beyond these factors[1]. W and M are the weight matrices that give the relationship between units. In the literature, W and M, are usually equivalent weight matrices based off the individual's peer group. The empirical specification can be estimated through maximum-likelihood (ML) methods or by general method of moments (GMM) procedures.

Even though spatial analysis of social interaction models focus on social networks to derive the spatial weights matrices, distance-based matrices can be useful to these models. Using geo-coded data to create a distance-based matrix can control for the impact of the environment or neighborhood effect. This may not get at the causal mechanism but it is an improvement because it accounts for spatial dependence (Lesage and Pace, 2009). Savitz and Raudenbush (2009) show that modeling spatial dependence can improve the measurement of neighborhood social processes.

4 EMPIRICAL FRAMEWORK

4.1 Data

The data is taken from the National Longitudinal Study of Adolescent Health (Add Health). Beginning with an in-school questionnaire administered to a nationally representative sample of students in grades 7 through 12 in 1994-95 (Wave 1), the study follows up with a series of in-home interviews of respondents approximately one year (Wave 2; 1996), six years (Wave 3; 2001-2002), and thirteen years

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[1] Lee et al (2010) show that incorporating the group fixed effect can mitigate the omitted variable bias. In the estimation in section 4.2, I do not incorporate group fixed effect but instead estimate the SARAR model which includes the spatial lag of the dependent variable, explanatory variables, spatial lags of the explanatory variables along with the spatial lag of the disturbances. Lesage and Pace (2009) show that the SDM can also mitigate the omitted variable bias that plagues standard regression analyses.

later (Wave 4; 2007-2008). The sample created is limited to African-American adolescents in the In-Home Survey in Wave 1. While the In-School Survey is preferred, that survey does not contain detailed questions on sexual activity. Individuals who are married are also removed from the sample since the focus is on pre-marital activity. Individuals without valid friendship nomination data are also removed. The total number of observations is 3,504.

The dependent variable is early sexual initiation, defined as whether the individual has ever had sexual intercourse by the age of thirteen. There are many definitions of early sexual initiation ranging from thirteen up to sixteen. In this study, I follow the definition in the CDC study that asks about sexual activity before the age of thirteen. The explanatory variables are categorized into four groups: demographics, risk/attitudes, family, and peer. Individual factors include basic demographics like gender, age, and knowledge of pregnancy and AIDS risk. I include three measures of religiosity: whether the respondent is Catholic, if they report no religion, and whether they attend religious services at least once a week. Adamczyk and Felson (2006) show that peers' religiosity has an influence on sexual initiation, which is mediated by the denseness of the friendship network. Grade is included as an explanatory variable only in the model where the social network is nominated friends.

There are variables that measure the respondent's attitude towards sex and risk. These attitudes can explain behavior that does not fall within traditional economic theory. Behavioral models of risky behavior posit that individuals misperceive costs and benefits and have high discount rates (O' Donogue and Rabin, 2001). Questions that can proxy for behavioral factors include whether the respondent is likely to go to college, whether they believe they will live to age 35, whether they believe they will be killed by age 21, and whether they are likely to contract HIV. These questions represent how an adolescent perceives their future. Several scholars have shown that discrimination plays a role in risky sexual behavior for African-Americans (Roberts et al, 2012), so included is whether the respondent believes students at their school are prejudiced.

Family factors include family structure and characteristics of the parents. Whether the individual lives in a household with both biological parents is included as an explanatory variable. Family structure

has been shown to be an important factor in adolescent sexual behavior (Ali and Ajilore, 2011; Davis and Friel, 2001). Other parental characteristics included are each parent's level of education, if both parents work full-time, and whether the mother is on public assistance. I also include mother's approval of the respondent engaging in sexual activity and whether the mother approves of the respondent's use of birth control. To control for neighborhood factors, I include community-level fixed effects.

The measurement of peer influences in the literature is accounted for in questions that ask the respondent about their peers. However, these formulations of peer influence suffer from the "reflection" problem defined earlier. The spatial model described in (2) provides the proper accounting of peer influence.

(2) $Y = \alpha i + \lambda WY + X\beta + WX\theta + u, u=\rho Mu+\epsilon$

The endogenous peer effect (λWy) and the contextual effects ($WX\theta$) represent the peers' sexual activity and the peers' characteristics, respectively. Table 1 provides the summary of the variables.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Dependent Variables				
Early Sexual Initiation	0.03	0.17	0	1
Independent Variables				
Gender (Male=1)	0.47	0.50	0	1
Age	15.5	1.7	12	18
Grade	9.55	1.62	7	12
Catholic	0.05	0.21	0	1
Attend Religious Services	0.49	0.50	0	1
No Religion	0.09	0.28	0	1
Sex Education (Pregnancy)	0.89	0.31	0	1
Sex Education (AIDS)	0.93	0.26	0	1
Prejudice	2.68	1.20	1	5
Likely Attend College	4.24	1.08	1	5
Will Live to Age 35	4.18	0.94	1	5
Will Be Killed by Age 21	4.31	0.87	1	5
Will Get HIV	1.47	0.76	1	5
Two Bio-Parent Household	0.33	0.47	0	1
Mom Approves Sex	1.85	0.97	1	5
Mom Approves Birth Control Use	3.09	1.49	1	5

Mother on Public Assistance	0.16	0.37	0	1
Mother's Level of Education	5.76	2.25	0	9
Mother works Full-Time	0.63	0.48	0	1
Father's Level of Education	2.62	3.26	0	9
Father works Full-Time	0.37	0.48	0	1

Table 1 shows that only 3% have had sex by the age of 13. Less than half of the sample is male while the average age is 15. About half of the sample attends religious services with 4.5% being Catholic and 8% having no religion. Most of the respondents have had sex education talking about pregnancy and AIDS. Most of the sample believes they will attend college, will live to age 35, will not be killed by age 21, and do not think they will get HIV. One-third of the sample lives with both biological parents. Mothers tend to have higher levels of education than fathers and they tend to be employed more than fathers. Finally, 16% of the respondents' mothers are on public assistance.

4.2   Methodology

This study estimates the effect of peers on early sexual activity using a social interactions model. This model includes the endogenous peer effect, contextual effects, and correlated effects. Following Arraiz et al (2010), I estimate a variant of (2) that does not include the group fixed effect. Instead, the spatial model includes a spatial lag of the dependent variable, explanatory variables, spatial lags of the explanatory variables, and spatial lags of the disturbances.

(2') $Y = \lambda WY + X\beta + WX\theta + u, u = \rho Mu + \epsilon$

Letting $Z = [X, WY]$ and $\delta = [\lambda, \beta]$, the model can be written as follows[2]:

(3) $Y = \delta Z + u, u = \rho Mu + \epsilon$

Performing a spatial Cochrane-Orchutt transformation to the model by pre-multiplying by $I - \rho M$, the model becomes:

(4) $Y^* = \delta Z^* + \epsilon,$

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[2] X includes both the explanatory variables and the spatial lags of the explanatory variables.

where $Y^* = (I - \rho M)Y$ and $Z^* = (I - \rho M)Z$. Arraiz et al (2010) propose a generalized spatial two-stage least squares (GS2SLS) estimator to compute estimates for ρ and δ. This is two-step procedure where δ is estimated by two-stage least squares applied to (4) using a set of instruments. Kelejian and Prucha (1998) explore linearly independent columns consisting of X, WX, W^2X, etc. as valid instruments[3]. The second step calculates an efficient GMM estimator of ρ using GS2SLS residuals. As long as I, W, and W^2 are linearly independent, the model is identified. Bramoulle et al (2009) show that if peers of peers do not directly affect an individual then the characteristics of the peers of peers' can be used as instruments of the peers' behavior.

To incorporate the influence of the peer groups, two weight matrices are created representing each type of peer group. The first matrix is comprised of individuals who are in the same grade within the same school. The second matrix is comprised of individuals and their nominated friends. In the first weight matrix, individuals in the same grade within the same school are given a 1 and a zero, otherwise. In the second weight matrix, individuals and their nominated friends are given a 1 and zero, otherwise. Each matrix is normalized by row so for each individual the sum of the values are equal to one. The purpose is to make sure that we are measuring the average of peers' behavior, instead of the sum. For example, if one adolescent has three individuals in their peer group, each peer accounts for 1/3 influence. If another adolescent has twenty individuals in their peer group each peer accounts for 1/20 influence.

4.3   Results

While most studies use maximum likelihood[4] (ML) methods to estimate (4), Arraiz et al (2010) show that the maximum likelihood estimator performs well only in the case where the errors are homoskedastic. For this study, I use the GS2SLS estimator and allow for the disturbances to be heteroskedastic. Table 2 provides the results of GS2SLS estimation of peer effects on whether the individual has made their sexual debut by age thirteen. The peer group is made up of individuals who are

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[3] The spreg command in STATA use X, WX, and W^2X as the default set of instruments.
[4] Blankmeyer et al (2011); Lin (2010)

in the same grade within the same school[5]. This is a suitable reference group because it is possible that youth take social cues from individuals outside of their specific friendship network. If youth in a popular social group engage in sexual activity or is perceived by an adolescent to engage in sexual activity, this could induce that adolescent to engage in sexual activity (Brechwald and Prinstein, 2011)). Warner et al (2011) state, "It is important to recognize that while youth are likely to be influenced by their close peers, their attitudes and behaviors can be affected by other peers with whom they are not directly acquainted."[6]

The endogenous peer effect measures whether sexual activity by individuals in the school-grade influences an individual's decision to engage in sexual activity and the contextual effects measure how the characteristics of those in the school-grade influence an individual's decision to engage in sexual activity. The rho term (ρ) measures spatial dependence in the errors and measures the influence of the shared environment among peers. Community level fixed effects measure the influence of the shared environment within the community.

Table 2. GS2SLS Estimation of Peer Effects on Early Sexual Initiation

	(1)	(2)	(3)
Spatial Parameters			
Endogenous Peer Effect (λ)	0.0342***	0.0445***	0.6969***
ρ	-0.0139	0.0340	-0.5225***
Own Characteristics			
Gender (Male=1)	0.0067	0.0075	0.0092
Age	-0.0319***	-0.0288***	-0.0275***
Catholic	-0.0310***	-0.0240***	-0.0257***
Attend Religious Services	-0.0103	-0.0108	-0.0136**
No Religion	-0.0089	-0.0098	-0.0070
Sex Education (Pregnancy)	0.0001	0.0010	-0.0034
Sex Education (AIDS)	-0.0165	-0.0136	-0.0116
Prejudice	0.0020	0.0019	0.0035
Likely Attend College	-0.0029	-0.0021	0.0010
Will Live to Age 35	-0.0042	-0.0040	-0.0034
Will Be Killed by Age 21	-0.0039	-0.0039	-0.0036
Will Get HIV	-0.0051	-0.0079	-0.0076
Two Bio-Parent Household	-0.0052	-0.0067	-0.0005

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[5] The reference group has been used by several papers. See Halliday and Kwak (2012).
[6] Warner et al (2011), pg. 1678.

Mom Approves Sex	0.0086**	0.0084**	0.0077**
Mom Approves Birth Control Use	0.0094***	0.0094***	0.0094***
Mother on Public Assistance	-0.0230***	-0.0241***	-0.0288***
Mother's Level of Education	-0.0012	-0.0017	-0.0022
Mother works Full-Time	-0.0052	-0.0061	-0.0051
Father's Level of Education	0.0020	0.0018	0.0005
Father works Full-Time	-0.0084	-0.0051	-0.0072
Contextual Effects			
Gender (Male=1)	-0.0012	-0.0004	-0.0071
Age	0.0009***	0.0011***	0.0231***
Catholic	-0.0039	0.0040	0.0173
Attend Religious Services	-0.0005	0.0005	0.0072
No Religion	0.0007	-0.0013	0.0073
Sex Education (Pregnancy)	0.0002	0.0026	0.0082
Sex Education (AIDS)	-0.0019	-0.0003	0.0063
Prejudice	0.0003	-0.0003	-0.0056
Likely Attend College	-0.0009	-0.0004	-0.0022
Will Live to Age 35	-0.0013	-0.0013	-0.0007
Will Be Killed by Age 21	-0.0015**	-0.0016**	0.0060
Will Get HIV	0.0016**	-0.0014	0.0129**
Two Bio-Parent Household	0.0006	-0.0018	-0.0021
Mom Approves Sex	-0.0007	-0.0008	-0.0011
Mom Approves Birth Control Use	-0.0001	0.0001	-0.0085***
Mother on Public Assistance	-0.0052***	-0.0048**	0.0285**
Mother's Level of Education	0.0008***	0.0003	0.0030
Mother works Full-Time	-0.0018	-0.0032	-0.0021
Father's Level of Education	0.0004	0.0003	0.0024
Father works Full-Time	-0.0066***	-0.0035	0.0002
W	School-Grade	School-Grade	Nearest-Neighbor
M	School-Grade	Nearest-Neighbor	Nearest-Neighbor
School Fixed Effects	No	Yes	Yes
Community Fixed Effects	Yes	No	No

*** - sig. at the 1% level; ** - sig. at the 5% level

Column (1) provides the results of the model. The endogenous peer effect is positive and significant, while the spatial parameter on the error is not significant. Age and being Catholic are negative and significant. Mother approval of sexual activity and birth control use are positively related to early sexual initiation, but having a mother on public assistance in negatively related to early sexual initiation. The

contextual effects find that having peers who are older, peers who believe they will get HIV, or peers with mothers with higher level of education is positively related to early sexual initiation. Peers who believe they will be killed by 21, peers who have mothers on public assistance, and peers with fathers who work full-time are negatively related to early sexual initiation.

As a robustness check, I vary the definition of the two spatial weight matrices and including school fixed effects instead of community fixed effects[7]. In column (2), I replace the weight matrix, M, on the disturbances with a distance-based matrix made up of the three nearest neighbors[8]. This matrix measures the influence of the shared environment from the neighborhood instead of the school. To measure the influence of the shared environment from the school, I include school fixed effects. The results are similar except mother's level of education and father working full-time are no longer significant. In the column (3), I let W and M be distance based matrices, so the model estimates neighborhood peer effects. The major difference in the results is that along with the endogenous peer effect, the spatial parameter on the disturbances is significant and negative.

5   FRIENDSHIP NETWORKS

5.1   The Add Health dataset gathered data on specific friendship networks in the Wave I and Wave II In-Home Survey and the Wave I In-School Survey. Students were asked to name up to five male friends and five female friends. Not all of the friends were located in the same school. While adolescents can get social cues from individuals within their grade, close friends have a direct influence on adolescents. In a sample of African-American adolescents in San Francisco, Harper et al (2004) describe the influence of close friends on dating and sexual relationships. One mechanism of influence is through the facilitation of acquiring dating and sexual partners. I expect similar results to Table 2, where the endogenous peer effect is positive. However, the contextual effects may be different since adolescents have more intimate contact with their close friends.

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[7] I also estimated including the community fixed effects and the results were similar.
[8] Weight matrices were created using the STATA user-created program SPWMATRIX (Jeanty, 2010).

This section conducts the analysis with the endogenous peer effect measuring the influence of an individual's nominated group of friends. The spatial weight matrices, W and M, now are social network matrices composed of the individual's nominated friends within the same school[9]. Table 3 provides the results.

Table 3. GS2SLS Estimation of Peer Effects on Early Sexual Initiation – Nominated Friends

	(4)	(5)	(6)
Spatial Parameters			
Endogenous Peer Effect (λ)	-0.0055	-0.1247	-0.0048
ρ	-0.0299	0.1158	-0.0305
Own Characteristics			
Gender (Male=1)	0.0115	0.0123**	0.0108
Age	-0.0379***	-0.0396***	-0.0372***
Grade	0.0145***	0.0054	0.0140***
Catholic	-0.0230***	-0.0260***	-0.0234***
Attend Religious Services	-0.0128**	-0.0132**	-0.0118
No Religion	-0.0105	-0.0118	-0.0106
Sex Education (Pregnancy)	-0.0049	-0.0047	-0.0047
Sex Education (AIDS)	-0.0067	-0.0076	-0.0081
Prejudice	0.0022	0.0022	0.0020
Likely Attend College	-0.0018	-0.0001	-0.0017
Will Live to Age 35	-0.0048	-0.0041	-0.0049
Will Be Killed by Age 21	-0.0026	-0.0025	-0.0027
Will Get HIV	-0.0063	-0.0062	-0.0062
Two Bio-Parent Household	-0.0053	-0.0043	-0.0053
Mom Approves Sex	0.0083**	0.0092**	0.0082**
Mom Approves Birth Control Use	0.0085***	0.0079***	0.0085***
Mother on Public Assistance	-0.0227***	-0.0207**	-0.0218***
Mother's Level of Education	-0.0023	-0.0031**	-0.0021
Mother works Full-Time	-0.0043	-0.0046	-0.0036
Father's Level of Education	0.0012	0.0015	0.0013
Father works Full-Time	-0.0043	-0.0065	-0.0042
Contextual Effects			
Gender (Male=1)	0.0107	0.0131	0.0109
Age	-0.0143**	-0.0143**	-0.0143**
Grade	0.0226**	0.0208**	0.0224**
Catholic	-0.0161	-0.0168	-0.0158

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[9] Individuals could nominate peers in sister schools or at schools not in the sample.

Attend Religious Services	-0.0294**	-0.0339**	-0.0293**
No Religion	-0.0587***	-0.0511***	-0.0586***
Sex Education (Pregnancy)	0.0204	0.0247	0.0205
Sex Education (AIDS)	-0.0054	-0.0129	-0.0050
Prejudice	-0.0104**	-0.0106**	-0.0104**
Likely Attend College	0.0096	0.0109**	0.0095
Will Live to Age 35	-0.0107	-0.0087	-0.0107
Will Be Killed by Age 21	0.0175***	0.0189***	0.0175***
Will Get HIV	0.0017	0.0023	0.0018
Two Bio-Parent Household	0.0217	0.0182	0.0218
Mom Approves Sex	0.0055	0.0055	0.0055
Mom Approves Birth Control Use	-0.0130**	-0.0114**	-0.0130**
Mother on Public Assistance	0.0160	0.0189	0.0164
Mother's Level of Education	-0.0016	-0.0013	-0.0016
Mother works Full-Time	-0.0119	-0.0151	-0.0119
Father's Level of Education	-0.0037	-0.0040	-0.0037
Father works Full-Time	-0.0028	0.0023	-0.0032
School Fixed Effects	Yes	No	Yes
Community Fixed Effects	No	Yes	Yes

*** - sig. at the 1% level; ** - sig. at the 5% level

Focusing on column (6) there are several differences from estimating the model with a more specific social network. In column (6), both school fixed effects and community fixed effects are included. The own characteristics do not differ in terms of sign and significance. However, the results show the endogenous peer effect is not significant, but more contextual effects are significant. This is an intriguing result because it shows that adolescents tend to be more influenced by others in the grade rather than their specific friends.

6   CONCLUSION

Adolescent sexual activity is a concern because of the negative outcomes associated with this behavior like unintended pregnancies and sexually transmitted infections. This is of particular concern for the African-American community because of the high prevalence of sexual activity relative to other ethnic groups (CDC, 2011). There are a variety of theories as to the causes including parental factors, peer effects, and neighborhood effects (Buhi and Goodson, 2007). The role of peer effects and risky sexual

behavior has been studied in a variety of literatures (Ali and Dwyer, 2011; Fletcher, 2007; Metzler et al, 1994; Romer et al, 1994; Sieving et al, 2006). There is a consensus that an individual's friends play a large role in their decision to engage in sexual activity (Bearman and Bruckner, 1999; Buhi and Goodson, 2007). However, the analysis of peer effects has limited within the existing empirical research by focusing solely on the endogenous peer effect. There are several mechanisms into which peers influence an adolescent's behavior and there needs to be an appropriate methodology to properly estimate these mechanisms (Manski, 2000).

This study uses a social interaction framework to estimate the influence of peers on sexual initiation by African-American adolescents using the Add Health dataset. The social interaction framework allows for the incorporation of social networks and neighborhood effects. Using spatial analysis to estimate the social interaction model solves the "reflection" problem that plagues many studies of peer effects. A key finding is that while peer effects exist for African-American adolescents, the effect disappears when we change the peer group definition from the school-grade to circle of friends. The policy implications are that interventions should be focused on the whole class instead of working specifically through friends. In the only study to date that uses social interaction models, Fletcher (2007) does not find any significant peer effects for African-Americans using a two-stage least squares procedure with fixed effects. His sample is taken from the National Education Longitudinal Study (NELS) and the outcome is having sex by tenth grade. This may explain the difference in results. More research using social interaction models needs to be done in studying adolescent risky behavior. This framework is useful for all types of adolescent risky behavior like smoking, drinking, and drug use.

Peer groups were defined by the school-grade and nominated friends. Future studies will exploit further more detailed social network data from the Add Health study to estimate the role of close friends on sexual initiation and risky sexual behavior. Majumder (2006) argues that policies focusing on best friends rather than broad peer groups may be more effective. Another avenue for future research is to link risky sexual behavior to the contraction of sexually transmitted infections (STI). A two-step procedure, similar to Fortin and Yazbeck (2011), can be used to relate the influence of peer effects on risky sexual

behavior and the transmission of STIs. It is not sufficient to outline the factors that lead to risky sexual behavior, but the broader impacts need to be discussed. Policies to curb adolescent sexual activity need to focus on the influence of peers as well as individual level factors (Kinsman et al, 1998).

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