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Religious Participation and Risky Health Behaviors among Adolescents

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Abstract

Previous studies have shown that adolescent religious participation is negatively associated with risky health behaviors like cigarette smoking, alcohol consumption, and illicit drug use. One explanation for these findings is that religion directly reduces risky behaviors because churches provide youths with moral guidance or with strong social networks that reinforce social norms. An alternative explanation is that both religious participation and risky health behaviors are driven by some common unobserved individual trait. We use data from the National Longitudinal Study of Adolescent Health and implement an instrumental variables approach to identify the effect of religious participation on smoking, binge drinking and marijuana use. Following Gruber (2005), we use a county-level measure of religious market density as an instrument. Religious market density has a strong positive association on adolescent religious participation, but not on secular measures of social capital. Upon accounting for unobserved heterogeneity, we find that religious participation continues to have a negative effect on illicit drug use.

JEL Codes: I1, Z12

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1. Introduction

Religious participation has been linked to several beneficial outcomes like increased educational attainment, reduced divorce rates, and lower mortality. In addition, many studies report that religious participation is associated with a reduced propensity to engage in risky health behaviors like smoking, drinking, and illicit drug use. Findings from the adolescent population are of special interest given the consequences of risky behaviors for both long-term health and educational attainment. It may be that religion directly deters adolescents from engaging in risky behaviors by instilling moral values and self-control skills. Alternatively, religious participation may deter risky behaviors by helping adolescents develop social networks, which provide social support and reinforce conformity to widely-accepted social norms.

Many scholars, however, have expressed concerns regarding the causal nature of the association between religion and adolescent risky health behaviors. Iannaccone (1998) notes that unobservable characteristics may be correlated with both religious participation and individual behavior. If "'good' kids …avoid drugs, stay in school *and* go to church," then the statistical relationship may represent correlation rather than causation (p.1475). Yet, few studies in this area have addressed the problem of unobserved heterogeneity directly. A handful of studies on adult religious participation have employed instrumental variables (IV) approaches (e.g., Gruber 2005; Gruber and Hungerman 2008; and Borgonovi 2008). The only such study to do so in an adolescent sample is Lillard and Price (2007), which finds mixed support for the causal effects of religion on youth smoking, drinking, and drug use.

The present study adds to the small literature on the causal effects of religious participation on adolescent risky behaviors. We employ data from the National Longitudinal Study of Adolescent Health (Add Health). Following Gruber (2005) we use a county-level

measure of religious market density as an instrumental variable for religious participation. We first demonstrate that religious market density has a strong positive effect on the frequency of religious participation among adolescents. Further, we find that even upon accounting for the endogeneity of religious participation, adolescents who attend services more frequently are less likely to use marijuana. In contrast, the IV estimates show little association between religious participation and either smoking or binge drinking.

2. Previous Literature

The literature on the association between religion and risky health behaviors is vast. Rew and Wong (2006) describe more than 43 empirical studies of adolescent health behaviors and religion, and Johnson, Tompkins, and Webb (2002) review over 150 studies on religiosity and substance abuse. Despite the large number of studies, however, only a few attempt to identify a causal effect of religion on behaviors or outcomes.

The small number of such studies highlights the challenge of identifying a factor that affects religious participation, but has no effect on behaviors. While no study has identified a valid individual-level instrument, several have employed area-level instrumental variables building on prior economic research on religious markets. As Iannaccone (1998) describes, this work dates to the observation by Adam Smith (1776) in *The Wealth of Nations*, and includes several, more recent, empirical analyses of religious participation and religious market traits. As described below, the studies using market traits to identify religious participation effects differ in the specific instrument used, the age of the population studied, and the outcomes examined.

Focusing on adults and young adults, Gruber and Hungerman (2008) employ a novel identification strategy based on the repeal of "blue laws" across U.S. states largely in the 1970s and 1980s. They posit that blue laws, which ban commercial activities like shopping and

purchasing alcohol on Sundays, insulate religious activity from secular competition. Thus, the repeal of these laws should expand alternatives to religious participation and decrease service attendance. Further, if attendance has a deterrent effect on risky health behaviors, then blue law repeals should increase heavy drinking and drug use. Using data from the General Social Survey (GSS), Gruber and Hungerman first show that the repeal of blue laws led to declines in both religious participation and religious donations by adults. They then demonstrate that among young adults in the National Longitudinal Survey of Youth (NLSY-79), blue law repeal led to significant increases in marijuana and cocaine consumption.

Lillard and Price (2007) follow Gruber and Hungerman's blue law approach to study youth risky behaviors. Using data from the Panel Study of Income Dynamics, and focusing on respondents between ages 5 and 30, the authors examine the onset of smoking behavior. Interestingly, respondents living in states that repealed blue laws were significantly less likely to start smoking. However, the interaction of living in a state that repealed a blue law and belonging to a religion for which Sunday is the day of obligation had a positive effect on smoking onset (albeit somewhat smaller than the negative coefficient on the "no blue law" dummy). Differences between these findings and Gruber and Hungerman's may be due to differences in the age group and the outcome studied (illicit drug use versus smoking onset), or differences in the states included the sample. Gruber and Hungerman restrict their analysis to 16 states, while Lillard and Price use a larger group.

Lillard and Price (2007) also use propensity score matching to examine the effect of religious participation on youth behaviors. Using data from the Monitoring the Future surveys, they find that adolescents who participate in religious services monthly or more often are less likely to smoke, drink, and use drugs than those who go to church less often. Since matching estimators do not account for selection on unobservables, the authors follow Altonji, Elder, and

Taber (2005) in calculating the amount of selection on unobservables that could explain their results. With the exception of current smoking, most findings from the propensity score matching exercise could be explained if selection on unobservables were just a small fraction of the selection on observables.

Two additional studies use identification strategies based on characteristics of the religious market. Using data from the GSS, Gruber (2005) examines the link between religious participation and religious market density. Religious market density, or the share of the local population that is of an individual's own religion, may increase religious participation by reducing the distance to religious services and increasing access to social interactions linked to religion. Prior empirical work by Phillips (1998) and Olson (1998) provides evidence that church attendance increases with religious density. While density can be calculated from the GSS by aggregating respondents by area, the survey's relatively small sample makes this prone to measurement error. Partly out of concern for this, Gruber also uses a measure of "predicted religious density" based on the share of the area population that is of an ancestry that shares the individual's religion and calculated from the much larger Census public use microdata sample. Results show that the GSS-based measure of religious market density has a positive effect on GSS measures of attendance. Predicted religious density has a positive and significant effect on outcomes such as incomes and educational attainment, and a negative association with divorce rates. These results are consistent with the notion that religious density increases attendance which in turn leads to better economic outcomes.[1]

[1] Dehejia et al. (2007) consider a similar strategy for identifying the effect of parental religious involvement on children's outcomes. However, the instrument yielded imprecise estimates attributed to the small sample size (1,125 observations).

Finally, Borgonovi (2008) uses data on adult respondents to the Social Capital Community Benchmark Survey (SCCBS), and focuses on self-rated health and happiness as measures of individual well-being. Drawing on past findings that church attendance is greater in areas characterized by more competition among denominations, Borgonovi constructs a Herfindahl index of religious market concentration using county-level data on the shares of adherents bellowing to various denominations. Values closer to 1 indicate more concentration (less competition) and values closer to zero indicate less concentration (more competition). She finds that volunteering decreases with greater religious concentration, and that upon instrumenting for volunteering with concentration, religious volunteering has a positive and significant effect on happiness but an insignificant effect on health.

Our research builds on this small group of studies. Like Lillard and Price (2007), we focus exclusively on youths; like Gruber and Hungerman (2008) we look at heavy drinking and illicit drug use in addition to smoking. We use a measure of religious market density as an instrument, making our identification strategy most comparable to Gruber (2005).

3. Data and Estimation

We use data from Wave I of the National Longitudinal Study of Adolescent Health, or Add Health, a nationally representative study of roughly 20,000 adolescents in grades 7 through 12. Between April and December of 1995, respondents completed in-home interviews with detailed questions on tobacco, drug, and alcohol use, as well as their religious affiliation and attendance patterns, household composition, and demographic traits. Our analysis also uses data from interviews of the respondent's parent or guardian, surveys the adolescents completed in school, and surveys completed by administrators of the schools.

One advantage of Add Health is that it employs specific fielding procedures for data on sensitive topics. Most questions on the survey were posed directly to respondents by an interviewer who entered the answers into a computer. However, for the sensitive topics on which we focus (smoking, drinking, and drug use), adolescents listened to the questions on headphones and entered their answers on a laptop themselves. This approach has been shown to increase the validity of adolescent responses (e.g., Turner et al. 1998). Procedures were used to ensure that no one other than the adolescent heard the sensitive questions or answers given.

A limitation of Add Health is that geographic identifiers are unavailable in either the public or restricted use data, thus preventing researchers from merging individual records to local characteristics. This restriction protects the confidentiality of these highly sensitive data (thus, it may have the advantage of improving response rates and minimizing response bias). To define area-level variables including our instrument, we obtained the restricted use version of the Add Health data which includes access to a database of over 2,600 "contextual variables" defined at the level of the state, county, census tract or block level and prepared by the Add Health survey staff.

Our instrument for religious participation is religious market density, which is defined for each respondent as the proportion of the county population belonging to the same denomination as the respondent. We construct this with several variables in the contextual database taken from the 1990 survey of Churches and Church Membership (CCM), a survey conducted every ten years by the Association of Statisticians of American Religious Bodies (ASARB). In 1990, the ASARB survey included 33 Judeo-Christian church/congregational groupings. Congregations were asked to provide data on the number of adherents including full members of the congregation, children of full members, and persons who participate in services regardless of membership status. From the 1990 ASARB survey, the Add Health contextual database includes

the proportion of the county who are religious adherents, and the proportion of the population belonging to several broadly-defined denominations: Catholics, Jews, Moderate Protestants, Liberal Protestants, and Conservative Protestants.

Our measure of religious market density differs from the one used in Gruber (2005). First, Gruber's market density measure is based on seven classifications – the five we use plus "other" and "no religion." Because the contextual database does not include either the proportion other or none, these groups cannot be distinguished in our data. A second difference is that Gruber instruments for market density using the ancestral density of other ancestries with shared religious preferences as an instrument. The IV approach is motivated by concerns for measurement error since religious density is calculated from GSS responses aggregated by primary sampling unit. Because our measure of density is not calculated from the Add Health microdata, it is less prone to measurement error. Our measure may, however, pick up some majority status effects; i.e., that religious participation is driven by membership in a large group, but not necessarily a large *religious* group. Unfortunately, the contextual database does not include the area-level ancestry proportions required to execute Gruber's exact approach.

The data and identification strategy limit our sample in two ways. First, our sample excludes respondents who did not report a religious affiliation. Not only can religious market density not be defined for this group, but respondents who did not report an affiliation were not asked about religious attendance. This exclusion is made in prior studies of religious participation using Add Health data (e.g., Rostosky, Danner, and Riggle 2007; Nonnemaker, McNeely, and Blum 2003). Since the GSS asks about religious attendance for those who do not report an affiliation, Gruber (2005) is able to examine whether excluding non-affiliates makes a difference. He finds no substantive difference in the effects of density on attendance whether non-affiliates are included or excluded.

Second, we lose respondents in the "other" category, that is, respondents whose religious affiliation does not fit within the five groups for which we have religious density information. Specific denominations were classified into these groups following Roof and McKinney (1987).[2] Because we are not able to assign religious market density to adolescents from various "other" Protestant sects and from non Judeo-Christian faiths, our sample excludes Christian Scientists, Jehovah's Witnesses, and other undefined Protestants, as well as Baha'i, Buddhists, Hindus, Muslims, Eastern Orthodox, and "other" unspecified religious affiliations.

These restrictions affect our sample size, but not as much as missing data on other required variables. While the full Wave 1 sample contains 20,745 observations, about 1,800 are missing sampling weights and almost 400 respondents did not provide a response to the religious affiliation question. Of the remaining, about 3500 adolescents were missing parent interview data on age, education, and income (used as explanatory variables in our models).[3] Missing data on adolescent and school-level explanatory variables brought the sample size to about 13,978 individuals. Excluding the non-religious drops 1,714 observations, and excluding those with denominations outside of the five-category scheme drops 1,188 observations. The means in Table 1 are based on the resulting 11,077 observations; missing data on the risky behaviors reduces the estimation sample sizes slightly.

[TABLE 1 HERE]

[2] Specifically, Liberal Protestants include Episcopalians, Presbyterians, United Church of Christ, Friends/Quaker, and Unitarians. Moderate Protestants include Methodists, Lutherans, National Baptists, Disciples of Christ, and Black Baptists. Conservative Protestants include the Adventists, AME, Assemblies of God, Baptists, Congregationalists, Pentecostals, Holiness, and Latter Day Saints. This breakdown is similar to that followed by Gruber (2005).

[3] Cases where parents were asked the income question, but refused to answer, are included in the sample; their treatment is described below.

The descriptive statistics in Table 1 are calculated with the survey-provided sampling weights. The first portion of the table reports summary statistics for adolescent characteristics, starting with the three behaviors on which we focus. Smoking is represented by an indicator variable equal to 1 if the youth reports smoking at least one cigarette in the past 30 days. Our measure of alcohol use is binge drinking, which equals 1 if the adolescent consumed five or more drinks in a row during the past 12 months. For drug use, we define a variable equal to 1 if the respondent used marijuana within the past 30 days.[4] About one-fourth of the sample reported smoking and binge-drinking, and 13% used marijuana. The smoking participation rate is consistent with several estimates from prior studies (e.g., Ross and Chaloupka 2003; Powell, Tauras, and Ross 2005). The marijuana and alcohol consumption rates are consistent with rates reported in Nonnemaker, McNeely, and Blum (2003) and Clarke and Lohéac (2007). To measure religious participation, we use the survey question: "In the past 12 months, how often did you attend religious services?" We recode the four possible responses to this question to create a scale that equals 1 for never attends, 2 for less than once a month, 3 for once a month or more but less than once a week, and 4 for weekly or more. The mean response is 2.958, with a standard deviation of 1.09.

Table 1 also presents means for the explanatory variables in models of religious participation and risky behaviors. We control for the adolescent's religious affiliation, sex, age, race and ethnicity, and for parent age, educational attainment, residence in the household, and mother's employment status. We include controls for household size and family income; given the number of refusals by parents to the income question (even for those who completed the

[4] We focus on marijuana consumption because the rates of other drug usage were very low. Only 1% report use of cocaine, 2% use inhalants, and 4% use a combined listing of "other" drugs including LSD, ecstasy, PCP, mushrooms, speed, heroin, and pills without prescriptions.

parent questionnaire), we created an indicator variable for refusals and a set of indicator variables based on ranges of parent income, coding these to zero for the refusals.

To account for as many influences on religious participation and risky behaviors as possible, we also control for a large number of area-level and school-level characteristics. Using data from the contextual database, we control for median household income in the county, percentage of the county that is urban, county-level race density (percentage of the population that is of the same race as the respondent), county-level age and sex density (percentage of the population that is of the same age and sex as the respondent), and county population density.[5] We include proportion Hispanic, indicators for region of residence (South, Midwest, and West, relative to Northeast), and the state excise tax per pack of cigarettes. From the school administrator survey, we construct indicator variables for religious schools, large or medium school size, the presence of school polices related to alcohol and drug expulsion, and the availability of drug abuse programs in the school. From the in-school questionnaire (completed by nearly 90,000 students), we construct the proportion of smokers at each school.

4. Results

We first demonstrate that the proposed instrument, religious market density, meets some of the criteria for valid instruments. In Table 2, we report results from models of participation in which religious market density is included as an explanatory variable. All models were estimated using the survey-provided sampling weights, and robust standard errors were calculated to account for the clustering of observations at the primary sampling unit (the school). All models include the full set of explanatory variables shown in Table 1; the complete results are available upon request.

[5] Gruber (2005) includes similar controls in a model of religious participation.

[TABLE 2 HERE]

In the first two rows of Table 2, the dependent variable is a measure of religious participation, starting with our preferred four-category measure, and also including a binary variable equal to 1 if the respondent ever attends. In these regressions, the coefficient on religious market density is positive and statistically significant. *F*-statistics for religious density in these models are 20.9 and 17.4. Both the sign and significance of the religious density measures are supportive of our identification strategy. As such, our findings show that religious market density is an important determinant of adolescent religious participation, building on the Gruber (2005) finding for adults in the GSS.

It is possible that the association between religious density and participation is picking up some county-level trait associated with increased secular involvement or non-religious social capital. To see if this is the case, we define several measures of secular involvement for adolescents from the in-school interview and for parents from the parent interview. As shown in Table 2, there is no evidence of a significant positive association between religious market density and whether or not a student participates in clubs or sports, or the number of clubs and sports in which a student participates. Three of the four coefficients are negative, and in the case of sports participation, the negative effect of religious market density is statistically significant. When parent measures are used as dependent variables, there is no evidence that parents in areas with higher religious market density are more likely to belong to clubs, civic associations, or parent-teacher organizations.[6] These findings thus offer further support for our identification strategy.

[6] The parent interview also includes questions on membership in labor unions and veterans organizations. We do not report results using these variables as dependent variables, since both are closely tied to parent work history. Regardless, religious market density is not positively associated with those measures either.

In Table 3, we report single equation linear probability models for comparison, followed by regressions using religious market density as an instrument for religious participation. In the top panel, the sample includes respondents at all schools. In the single equation models, the estimated coefficient on religious participation is negative and significant for smoking, binge drinking, and marijuana use. This is expected given the ample evidence from prior studies that adolescents who participate in religious services more frequently are less likely to engage in risky behaviors. The IV models show a different pattern of results. For example, both the IV estimates of the effects of religious participation on smoking and drinking are smaller in magnitude than the OLS effects, and are not statistically different from zero. Yet, for marijuana use, the IV estimate remains negative and statistically significant (at the 0.10 level) and is larger in magnitude than the OLS estimate. Thus, accounting for unobserved heterogeneity increases the deterrent effect of religious participation on illicit drug use. This result is similar to findings reported in Gruber and Hungerman (2008) in which blue law repeals led to an increase in marijuana and cocaine use.[7]

[TABLE 3 HERE]

The models in the top panel of Table 3 include controls for whether the school is a religious school; nonetheless, it may be that the effect of religious attendance differs for students

[7] The effects of other explanatory variables on risk behaviors and religious participation are similar to those reported in the prior literature. For example, age has a positive and significant effect on all three risk behaviors. Adolescents who live with their biological father are less likely to engage in risky behaviors. Black respondents are less likely to smoke, consistent with Powell et al. (2005), DeCicca et al. (2002) and Ross and Chaloupka (2003). Binge drinking is greater among Catholics, and less likely for female or black respondents (Bartkowski and Xu 2007). Religious participation increases with parent's age and educational attainment and family income. The coefficients on female gender, Hispanic ethnicity, and Black race are all positive and significant in the participation models (consistent with Gruber and Hungerman 2008; Brown and Taylor 2007). Household size, maternal employment, residing with one's biological father, and school size are also positively associated with attendance frequency.

at religious and non-religious schools. We test for this by omitting religious schools from the sample, and re-estimating our models. The results are shown in the bottom panel of Table 3, and the OLS results are very similar to those based on students at all schools. Interestingly, the difference between the OLS and IV results for smoking and drinking is more pronounced in this sample. Here the IV estimates are also statistically insignificant, but have changed sign and are now positive. The IV estimate of religious participation on marijuana use is very similar to the all-school sample estimates, and remains significant at the 0.10 level. Also reported in Table 3 are results of tests of underidentification and weak identification that offer further support for our instrument.[8] In all models, we can reject the null hypothesis that the model is underidentified, and we are able to reject the null hypothesis that the model is weakly identified using the critical values reported in Stock and Yogo (2005).

Thus far, we have focused our attention on how risky behaviors are influenced by religious participation. While participation is the most widely-used measure of religiosity, several studies on religion and youth behaviors show that prayer frequency and adherence to specific beliefs (e.g., God, the afterlife, etc.) are also associated with improved outcomes and behaviors (Rew and Wong 2006). In addition, Dehejia et al. (2007) show that parents' religious participation has beneficial effects for their children. Using data from the National Survey of Families and Households, they estimate the association between parent religious participation during childhood (ages 3 to 19) and child outcomes 13 to 15 years later. Results suggest that parental religious participation mitigates the effects of economic disadvantage on subsequent educational attainment, income, the likelihood of smoking, and other outcomes.

[8] The test statistic for underidentification is the LM version of the Kleibergen-Paap *rk* statistic and the test statistic for weak identification is a Wald *F* statistic based on the Kleibergen-Paap *rk* statistic. Both tests are appropriate for clustered standard errors and are described in detail in Baum, Schaffer, and Stillman (2007).

The Add Health survey contains these alternate measures of religiosity; thus, we are able to examine their association with smoking, drinking, and drug use. In models not reported here, but available upon request, we find that the adolescent's self-reported prayer frequency and salience of religion (based on responses to "How important is religion to you?") are each associated with lower likelihoods of drug use, smoking, and binge drinking. In addition, the frequency of parents' religious participation is associated with a reduction in these risky behaviors. Further, religious market density has positive and significant coefficients in models of these three other measures of religiosity.

Because we lack a sufficient number of instruments to estimate a structural model that includes all possible measures of religiosity, we examine a reduced form model in which religious density is used as an explanatory variable in the models of risky behaviors. Results are reported in Table 4. In the all-school sample, religious market density has the expected negative effect on marijuana use, and is significant at the 0.10 level. The effect remains significant when students at religious schools are excluded. In the bottom panel of Table 4, we interact religious density with a dummy variable equal to 1 if the adolescent lived at the same residence during the survey (1995) as he or she did in 1990, the year to which the CCM data pertain. Here we find that religious market density has a statistically significant effect on marijuana use only for those adolescents who still lived at their 1990 residence. Because the accuracy of the instrument is best for this group, we take this as further support for our identification strategy. In terms of magnitude, the coefficient on the interaction term suggests that a one-standard deviation increase in religious market density (0.16 units) reduces the likelihood of marijuana use by 1 percentage point. This is a sizeable effect from this sample's mean of 13.4 percent. Direct comparisons of this estimate to other studies are not possible, but Gruber and Hungerman (2008) report very large effects of blue law repeals in their models of cocaine and marijuana use (pp. 853-855).

[TABLE 4 HERE]

Our results are robust to a number of specification changes. In the first stage, we obtain substantively similar results for the effect of religious market density when we include controls for parental attendance in the child participation models. We obtain similar results in both first-stage and IV models when we define religious attendance as either an indicator variable for any attendance (relative to none) or weekly attendance (relative to less frequent or none). We obtain the same pattern of results in the IV and reduced form models of smoking and drinking when the dependent variables are defined as "heavy" smoking (defined as smoking every day in the past 30 days) or drinking any alcohol within the past 12 months. Our IV models and reduced form models yield similar results when estimated as IV probit or probit models.[9]

5. Discussion and Conclusions

A large literature shows religious participation to be associated with various beneficial outcomes for adolescents, including higher educational attainment, reduced criminal activity, and better health and health behaviors. In contrast, a much smaller group of studies has attempted to address the potential endogeneity of religious participation. That group consists of a few studies using instrumental variables estimation in adult or young adult populations, and one study focusing on youths. While the studies on adults are generally supportive of a causal effect of religious participation on outcomes like happiness, illicit drug use, and income, the only known prior work on youths reports mixed support for the effects of attendance on smoking, drinking, and drug use.

[9] We estimate the IV models using *ivreg2* in Stata, which includes more enhanced tests of identification than *ivprobit*.

The present study adds to this small literature by applying instrumental variables estimation to data from the National Longitudinal Survey of Adolescent Health. We replicate past findings of single-equation analysis to show that adolescents who attend religious services more frequently are less likely to smoke, binge drink, or use marijuana. To deal with the potential endogeneity of attendance, we employ a county-level measure of religious density as an instrumental variable. We find that religious density is significantly associated with religious attendance. Adolescents who live in areas where greater proportions of the population adhere to their own faith have a higher frequency of attendance. When we use this variable as an instrument in IV models of smoking, drinking, and drug use, we find evidence that religious participation has a significant negative effect on marijuana use, even after accounting for its potential endogeneity.

Several limitations of our analysis should be noted. First, we cannot test for overidentification given that we have only one instrument. In other work not reported, we used the CCM shares in the contextual database to construct a religious Herfindahl index, similar to Borgonovi (2008). When entered as a quadratic into our first stage and IV models we found both coefficients to be statistically different from zero, but tests of redundancy in the IV models showed the terms added little to the model identification when religious density was also included. Second, we use only one cross-section, and are unable to include controls for youth fixed effects. The Add Health survey has multiple waves, but there are too few cross-county moves between Wave 1 and Wave 2 to generate within-panel variation in the instrument.

Despite these limitations, our results are quite similar to those estimated by Gruber and Hungerman (2008), who use an older sample of young adults and employ an alternative estimation strategy. Like that study, we find evidence that religious participation has a large negative effect on illicit drug use. Given the significant consequences of adolescent drug use,

our results provide important motivation for researchers attempting to identify the causal determinants of adolescent risky behaviors.

References

Altonji J, Elder TE, Tabor CR. 2005. Selection on observed and unobserved variables: assessing the effectiveness of catholic schools. *Journal of Political Economy* **113**(1): 151-184.

Bartkowski JP, Xu X. 2007. Religiosity and teen drug use reconsidered: a social capital perspective. *American Journal of Preventative Medicine* **32**(6S): S182-S194.

Baum, CF, Schaffer ME, Stillman S. 2007. Enhanced routines for instrumental variables/GMM estimation and testing. *The Stata Journal* **7**(4): 455-506.

Borgonovi F. 2008. Doing well by doing good. The relationship between formal volunteering and self-reported happiness. *Social Science and Medicine* **66**(1): 2312-2334.

Brown S., Taylor K. 2007. Religion and education: evidence from the national child development study. *Journal of Economic Behavior and Organization* **63**: 439-460.

Clark AE, Lohéac Y. 2007. It wasn't me, it was them! Social influence in risky behavior by adolescents. *Journal of Health Economics* **26**: 763-784.

DeCicca P, Kenkel D, Mathios A. 2002. Putting out the fires: will higher taxes reduce the onset of youth smoking? *Journal of Political Economy* **110**(1): 144 – 169.

Dehejia R, DeLeire T, Luttmer EFP, Mitchell J. 2007. The role of religious and social organizations in the lives of disadvantaged youth. Forthcoming in *An Economics Perspective on the Problems of Disadvantaged Youth,* Gruber J (ed.). National Bureau of Economic Research.

Gruber JH. 2005. Religious market structure, religious participation, and outcomes: is religion good for you? *Advances in Economic Analysis and Policy* **5**(1). Available at: http://www.bepress.com/bejeap/advances/vol5/iss1/art5

Gruber JH, Hungerman DM. 2008. The church vs. the mall: what happens when religion faces increased secular competition? *Quarterly Journal of Economics* **123**(2): 831-862.

Iannaccone LR. 1998. Introduction to the economics of religion. *Journal of Economic Literature* **36**: 1465-1496.

Johnson BR, Tompkins RB, Webb D. 2002. Objective hope: assessing the effectiveness of faith-based organizations: a review of the literature. *A Report from the Center for Research on Religion and Urban Civil Society*, University of Pennsylvania.

Lillard D, Price J. 2007. The impact of religion on youth in disadvantaged families. Manuscript, Cornell University Department of Economics.

Nonnemaker JM, McNeely CA, Blum RW. 2003. Public and private domains of religiosity and adolescent health risk behaviors: evidence from the national longitudinal study of adolescent health. *Social Science and Medicine* **57**: 2049-2054.

Olson D. 1998. The influence of religious pluralism on close social ties and religious involvement. Paper presented at the Annual Meeting of the Society for the Scientific Study of Religion.

Phillips R. 1998. Religious market share and Mormon church activity. *Sociology of Religion* **59**: 117-130.

Powell LM, Tauras JA, Ross H. 2005. The importance of peer effects, cigarette prices and tobacco control policies for youth smoking behavior. *Journal of Health Economics* **24**: 950-968.

Rew L, Wong YJ. 2006. A systematic review of associations among religiosity/spirituality and adolescent health attitudes and behaviors. *Journal of Adolescent Health* **38**: 433-442.

Roof WC, McKinney W. 1987. *American Mainline Religion: Its Changing Shape and Future*. New Brunswick, NJ: Rutgers University Press.

Ross H, Chaloupka FJ. 2003. The effect of cigarette prices on youth smoking. *Health Economics* **12**: 217-230.

Rostosky SS, Danner F, Riggle EDB. 2007. Is religiosity a protective factor against substance use in adulthood? Only if you're straight! *Journal of Adolescent Health* **40**: 440-447.

Stock JH, Yogo M. 2005. Testing for weak instruments in linear IV regression. In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, Andrews DW, Stock JH (eds.). Cambridge University Press.

Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. 1998. Adolescent sexual behavior, drug use and violence: increased reporting with computer survey technology. *Science* **280**(5365): 867-873.

Table 1. Descriptive Statistics

Variable	Definition	Mean
Adolescent Risk Behaviors(samples vary)		
Smoke	Equals 1 if adolescent smoked at least 1 day in the past 30 days; 0 otherwise (n=10,948)	0.257
Binge Drink	Equals 1 if adolescent drank 5 or more drinks in a row at least 1 day in past 12 months; 0 otherwise (n=10,972)	0.254
Marijuana Use	Equals 1 if adolescent smoked marijuana at least once in past 30 days; 0 otherwise (n=10,926)	0.130
Adolescent-level Explanatory Variables(n=11,077)		
Religious Attendance	Equals 1 if never attends, 2 if attends less than once a month; 3 if attends at least once a month but not weekly; 4 if attends weekly or more	2.958
Catholic	Equal to 1 if adolescent is Catholic; 0 otherwise	0.318
Mod. Protestant	Equal to 1 if adolescent is Moderate Protestant; 0 otherwise	0.236
Lib. Protestant	Equal to 1 if adolescent is Liberal Protestant; 0 otherwise	0.047
Con. Protestant	Equal to 1 if adolescent is Conservative Protestant; 0 otherwise	0.393
Jewish	Equal to 1 if adolescent is Jewish; 0 otherwise	0.007
Age	Adolescent's age in years	15.78
Female	Equal to 1 if adolescent is female; 0 otherwise	0.500
Hispanic	Equal to 1 if adolescent is Hispanic; 0 otherwise	0.120
Black	Equal to 1 if adolescent is Black; 0 otherwise	0.163
Asian	Equal to 1 if adolescent is Asian; 0 otherwise	0.030
Other Race	Equal to 1 if adolescent is another race; 0 otherwise	0.077
Parent and Household-level Explanatory Variables(n=11,077)		
Parent Age	Age of primary parent, in years.	41.48
High School	Equal to 1 if primary parent's highest level of education is high school or GED; 0 otherwise	0.335
Some College	Equal to 1 if primary parent's highest level of education is some college; 0 otherwise	0.292
College Grad	Equal to 1 if primary parent's highest level of education is college degree; 0 otherwise	0.131
Graduate Degree	Equal to 1 if primary parent's highest level of education is graduate degree; 0 otherwise	0.079
Income 2	Equal to 1 if household income >=10^{th} and <25^{th} percentile; 0 otherwise	0.115
Income 3	Equal to 1 if household income >=25^{th} and <50^{th} percentile; 0 otherwise	0.250
Income 4	Equal to 1 if household income >=50^{th} and <75^{th} percentile; 0 otherwise	0.237
Income 5	Equal to 1 if household income >=75^{th} and <90^{th} percentile; 0 otherwise	0.126

Table 1. Descriptive Statistics

Variable	Definition	Mean
Income 6	Equal to 1 if household income >=90th percentile; 0 otherwise	0.105
Income Refused	Equal to 1 if parent refused to answer household income question	0.094
Household Size	Number of persons in household roster	3.48
Mother Present	Equal to 1 if biological mother is listed in household roster; 0 otherwise	0.890
Father Present	Equal to 1 if biological father is listed in household roster; 0 otherwise	0.613
Mother Works	Equal to 1 if resident/biological mother works; 0 otherwise	0.743
Mother Works Missing	Equal to 1 if adolescent does not know or refuses to answer mother's work status; 0 otherwise	0.042
Area-level Explanatory Variables and Instrumental Variable (n=11,077)		
Cigarette Tax	State tax on pack of cigarettes (cents)	32.19
Median Income	Median household income in county	29,416
Pr (Urban)	Proportion urban in county	0.593
Area Density	Population density (persons/sq. km.) in county	0.468
Race Density	Proportion own race in county of residence	0.686
Pr (Hispanic)	Proportion Hispanic in county of residence	0.059
Age-Sex Density	Proportion same-sex 14-21 year-olds in county	0.059
South	Equals 1 if state is in South; 0 otherwise	0.419
Midwest	Equals 1 if state is in Midwest; 0 otherwise	0.288
West	Equals 1 if state is in West; 0 otherwise	0.143
Northeast	Equals 1 if state is in Northeast; 0 otherwise	0.150
Religious Density	Proportion of own religious group in county of residence	0.214
School-level Explanatory Variables (n=11,077)		
Religious school	Equal to 1 if school has a Catholic or other religious affiliation; 0 otherwise	0.073
Small school	Equal to 1 if school size is from 1-400 students; 0 otherwise	0.197
Medium school	Equal to 1 if school size is from 401-1000 students; 0 otherwise	0.450
Large school	Equal to 1 if school size is more than 1000 students; 0 otherwise	0.354
Pr (Smokers)	Proportion of students at school who reported smoking cigarettes in past year	0.355
Drug Expulsion	Equal to 1 is school has expulsion policy for illegal drug use at school; 0 otherwise	0.356
Alcohol Expulsion	Equal to 1 is school has expulsion policy for drinking alcohol at school; 0 otherwise	0.211
Drug Abuse Program	Equal to 1 if school has a drug abuse program on premises; 0 otherwise	0.460

Notes: Descriptive statistics are weighted by survey-provided sampling weights.

Table 2. Effects of Religious Density on Religious Participation and Other Activities

Dependent Variable	Dependent Mean (Std. dev.)	Coefficient on Religious Density (*t*-statistic)	*F*-statistic for Religious Density (*p*-value)
Frequency of Attendance (n=10,948)	2.958 (1.09)	0.518*** (4.57)	20.93 (0.0000)
Ever Attends Services (n=10,948)	0.864 (0.34)	0.141*** (4.17)	17.40 (0.0001)
Participates in Any School Activities (n=8,804)	0.527 (0.49)	-0.041 (1.00)	1.00 (0.320)
Number of School Clubs and Organizations (n=8,804)	0.958 (1.53)	0.209 (1.00)	0.99 (0.322)
Participates in Any School Sports (n=8,804)	0.572 (0.49)	-0.110* (1.71)	2.92 (0.090)
Number of School Sports (n=8,804)	1.158 (1.44)	-0.135 (0.63)	0.40 (0.529)
Parent Participates in Civic Organizations (n=11,334)	0.136 (0.343)	-0.020 (0.70)	0.49 (0.485)
Parent Participates in Hobby Clubs (n=11,312)	0.157 (0.364)	-0.078** (2.37)	5.61 (0.020)
Parent Participates in PTO (n=11,401)	0.327 (0.469)	-0.021 (0.49)	0.24 (0.623)

Notes: Absolute values of the *t*-statistics are in parentheses. Each row shows a different dependent variable used in a regression on religious market density. All models are estimated as OLS models using the sampling weights and clustering observations at the school-level. Models also include the full set of adolescent, parent, household, area, and school-level explanatory variables included in Table 1. Statistical significance is indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

Table 3. Effects of Frequency of Religious Attendance on Risk Behaviors

	Dependent Mean (Std. Dev.)	OLS	IV	Under-Identification Test	Weak Identification Test
Sample includes all schools					
Current Smoker (n=10,948)	0.257 (0.437)	-0.049*** (8.64)	-0.032 (0.35)	17.780 (0.0000)	20.926
Binge Drinking (n=10,972)	0.254) (0.436)	-0.038*** (7.28)	-0.031 (0.34)	19.194 (0.0000)	23.366
Marijuana Use (n=10,926)	0.130 (0.336)	-0.033*** (6.44)	-0.111* (1.77)	18.637 (0.0000)	22.242
Sample excludes religious schools					
Current Smoker (n=10,214)	0.260 (0.438)	-0.048*** (8.29)	0.004 (0.04)	18.744 (0.0000)	21.071
Binge Drinking (n=10,236)	0.257 (0.437)	-0.037*** (6.93)	0.027 (0.30)	20.068 (0.0000)	23.266
Marijuana Use (n=10,191)	0.129 (0.335)	-0.031*** (5.96)	-0.110* (1.67)	19.530 (0.0000)	22.042

Notes: Absolute values of the *t*-statistics are in parentheses. Regressions are estimated as linear probability models using the sampling weights provided in the survey, and accounting for the clustering of the observations at the school-level. Models also include the full set of adolescent, parent, household, area, and school-level explanatory variables included in Table 1. The critical values of the Stock and Yogo (2005) weak identification tests are: for 10% maximal IV size, 16.38; for 15% maximal IV size, 8.96; for 20% maximal IV size, 6.66; and for 25% maximal IV size, 5.53. Statistical significance is indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

Table 4. Effects of Religious Density on Health Risk Behaviors

	Current Smoker	Binge Drinking	Marijuana Use
Sample includes all schools			
Density	-0.017 (0.34)	-0.016 (0.33)	-0.059* (1.74)
F-test (*p*-value)	0.11 (0.736)	0.11 (0.741)	3.04 (0.084)
n	10,948	10,972	10,926
Sample excludes religious schools			
Density	0.002 (0.04)	0.014 (0.30)	-0.058* (1.64)
F-test (*p*-value)	0.00 (0.970)	0.09 (0.763)	2.68 (0.105)
n	10,214	10,236	10,191
Sample excludes religious schools; *Model interacts density with 1990 residence*			
Density	0.039 (0.66)	0.030 (0.55)	-0.006 (0.11)
Density*Residence 1990	-0.061 (1.13)	-0.026 (0.44)	-0.089* (1.66)
F-test of joint significance (*p*-value)	0.64 (0.529)	0.17 (0.843)	4.06 (0.020)
n	10,203	10,225	10,182

Notes: Absolute values of the t-statistics are in parentheses. Regressions are estimated as linear probability models using the sampling weights provided in the survey, and accounting for the clustering of the observations at the school-level. Models also include the full set of adolescent, parent, household, area, and school-level explanatory variables included in Table 1. Statistical significance is indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.