The impact of going to school at night on teenage risky behavior

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Abstract

We study the relationship between attending high school at night and the probability of engaging in risky behavior, such as having unsafe sex or consuming substances. To address potential endogeneity concerns we take advantage of a random assignment of high school students to daytime and night shifts in the city of Buenos Aires. Using an original survey on students attending their last year of high school, we find that girls attending high school in the evening start having sex at an earlier age and present a higher probability of getting an abortion. We find no significant differences for substance use. Our experimental approach suggests that the link between high school shift and risky behavior is causal. Results hold when we use an alternative sample of alumni.

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1 Introduction

The initiation in activities related to risky behavior such as having unsafe sex or consuming substances is, typically, an adolescent phenomenon. According to the National Center on Addiction and Substance Abuse at Columbia University (CASA, 2005), someone who does not initiate substance consumption by the age of 21 is almost certain never to do so. Therefore, the study of the determinants of entry into risky behavior should pay particular attention to events affecting the young. One of such events is attending high school. In this paper we study the relationship between attending high school at night and the probability of engaging in risky behavior.

There is an important body of research exploring the causes for risky behavior. There is some agreement that the decision to engage in risky behavior is a social phenomenon (Akerlof, 1997), and many papers have addressed the effects of peers and family on risky behavior. Soetevent (2006) surveys empirical papers identifying peer effects in the consumption of drugs, alcohol, and cigarettes. He concludes that peer effects on alcohol and cigarrettes consumption are always large and positive, while peer effects on drug use are sometimes positive and sometimes negative. Peer groups in the papers surveyed by Soetevent (2006) include neighborhood (Case & Katz, 1991), school mates and school environment (Clark & Lohéac (2007); Gaviria & Raphael (2001)), and classmates (Soetevent & Kooreman, 2007). Card & Giuliano (2013) investigate the influence of best friends on sex and substance use initiation, concluding that having a close friend who initiated a risky activity increases the probability of taking up such activity. In a recent contribution, Altonji *et al.* (2013) examine whether substance use of one child directly influences the behavior of a younger sibling and report evidence that smoking, drinking, and marijuana use are affected by the example of older siblings.[1] Finally, the National Center on Addiction and Substance Abuse (CASA) at Columbia University annual reports have consistently showed that having family dinners more than twice a week is associated with a lower probability of drinking, smoking, or using drugs.[2]

We contribute to this literature by providing empirical evidence of an additional cause for risky behavior; namely, attending school at night when adolescent. We estimate the impact of attending high school at night on the probability of getting an abortion, the age of intercourse initiation, and the probability of using substances. To the best of our knowledge, this treatment effect has not been studied before. Addressing the causal relationship between attending high-school at night and risky behavior is challenging, since the preference for nightlife is endogenous in a model of risky behavior. In order to overcome this endogeneity problem we take advantage of a natural experiment in Argentina. The public high school Escuela Superior de Comercio Carlos Pellegrini in the city of Buenos Aires, randomly assigns high school students to morning, afternoon, and evening shifts, thus generating an exogenous variation in the time students go to high school. The random assignment of shifts, the presence of very few non compliers, and the fact that in our sample there are no students that have rejected an offer to study at this high school regardless of the shift assigned, suggest that the link between high school shift and risky behavior is causal.

Our main finding is that girls attending high school in the evening present a higher probability of getting

[1] Previous papers reporting strong positive correlations between family members and substance consumption include Slomkowski *et al.* (2001) on sibling effects and Amuedo-Dorantes & Mach (2002) and Windle (2000) that focus on parent effects.

[2] CASA's reports were accessed at *www.casacolumbia.org/templates/publications_reports.aspx*.

an abortion and start having sex at a younger age than girls attending high school in the morning shift or in the afternoon shift. The effect of the night shift on sexual initiation is not clear for boys. Finally, we do not find a clear association between attending high school in the evening and substance consumption. We also explore potential mechanisms behind our findings, and we report evidence in support of an explanation related to the fact that adolescents attending school at night are less exposed to parental control. The lack of parental supervision of adolescents attending high school at night relaxes their budget constraint for risky behavior, but the budget constraint for risky behavior is more binding for girls than for boys.

Our findings are related to a small literature on the impact of time spent at school on adolescents' social and educational outcomes. A few papers focus on the relationship between high school schedule and teenage pregnancy. Kruger & Berthelon (2009) investigate the relationship between number of hours spent at school and the likelihood of teenage motherhood in Chile. They find that access to full-day schools reduces the probability of becoming an adolescent mother among poor families living in urban areas. Black *et al.* (2008) study whether increasing mandatory educational attainment through compulsory schooling legislation encourages women to delay childbearing in the US and Norway. They report evidence that increased compulsory schooling does in fact reduce the incidence of teenage childbearing. Our contribution to this literature is to show that the time of the day in which girls attend school has an effect on the age of sexual initiation and undesired fertility. Our paper is also related to the paper by Pope (forthcoming), who analyzes how the time of day affects students' productivity. He finds that productivity is higher in the morning than the afternoon. Instead of looking at student's productivity, we focus on risky behavior.

The rest of the paper is organized as follows. Section 2 describes the natural experiment and the instruments used to collect the data. Section 3 describes the variables used in the paper and presents randomization checks. Section 4 explains the estimation and inference strategies. Section 5 displays and analyses our main results. Section 6 discusses the mechanisms of the effects found. Finally, section 7 concludes.

2 Experimental design and data collection

2.1 Randomization of high school shift

In order to assess the causal impact of school shift on adolescence attitudes towards sex and substance consumption we take advantage from a natural experiment in a high school in the city of Buenos Aires. The high school *Escuela Superior de Comercio Carlos Pellegrini* (hereafter ESCCP) assigns incoming students to morning, afternoon, or night shifts through a public lottery. We describe the details of the experiment below.

ESCCP is a very prestigious public high school in the city of Buenos Aires. This high school directly depends on *Universidad de Buenos Aires*, the largest university in Argentina. As every high school in Buenos Aires, ESCCP has a five-year curriculum. Courses are taught in three shifts: the morning shift (from 07:30 am to 12:05 pm), the afternoon shift (from 12:30 pm to 5 pm), and the evening shift (from 05:20 pm to 09:40 pm). Because of its renowned quality of education and because tuition is free, every year the school faces an

excess demand of first year applicants. Among all applicants, eligible students are chosen according to their performance in admission examinations in Literature, Mathematics, History, and Geography. Once students are admitted, school authorities split them among 15 opening classes so that class size is homogeneous. This process is made in two steps.

The first step is to allocate each incoming student to one of the three school shifts. For the sake of transparency, shift allocation is made at a public lottery session held at the beginning of the first academic year, before classes begin. In this session, each incoming first year student is randomly assigned to one of the three shifts that they have to attend during the five years of high school. An exception is made to a minority of students that is allowed to choose the shift they desire to attend throughout high school based on their performance on the admission examinations and family background.[3] Once shift has been assigned ESCCP authorities strictly forbid any shift change or shift swap between any two students. However, every year a few exceptions are made and some students manage not to comply with the shift assigned though the lottery. Although non-compliance rates are very low (as we will show later in section 3), our empirical strategy (described in section 4) explicitly deals with the presence of non compliance.

The second step in the determination of classes is to split the stock of students allocated to each shift into five classes. School authorities in each shift distribute students so that class size, gender, and surname initial are balanced among classes.

At the end of the process, 15 classes of about 30 students each are formed at the beginning of the first years. The composition of classes is expected not to change for the whole duration of high school, meaning that except from non-compliants or dropouts a student's classmates are the same in all five years of high school.

2.2 The 2013 cohort survey

The data was obtained from a voluntary and anonymous survey taken by ESCCP fifth year students. The survey was designed by the authors and tested through a pilot survey (we describe the pilot survey in the next subsection). The survey was taken by all high school students attending their fifth year in 2013 (mainly 17 and 18 year-old students) that were present the day of our visit. Out a total of 381 students enrolled in fifth year in 2013 the survey was answered by 318 students (83.4% of the population). It is worth noticing that students did not know in advance that they would be subject to a survey.

The survey was administered early in September 2013, at the beginning of the last trimester before graduation.[4] The instrument was designed to measure treatment assigned, treatment received, outcomes related to sexual behavior and substance consumption, a set of pre-treatment characteristics, and a set of potential mechanisms for the impact of high school shift on the outcomes.

Information on treatment assigned and treatment received was gathered through a series of questions that allow us to identify those students that were exempt from the lottery and those students that did not comply

[3]The rules for lottery exemption have changed over time. For example, for some cohorts, students with the highest marks in the admission examinations were allowed to choose the shift they wanted to attend. In other years, students with older siblings in the school or with parents working at the school were allowed to choose to attend the same shift as their relatives work or attend school.

[4]In Buenos Aires the academic year starts early in March and ends early in December.

with the shift assigned. First, students were asked what shift they were drafted to in the shift lottery session. Multiple mutually exclusive choices were "I was exempt from the draft", "morning", "afternoon", and "evening". Second, respondents were asked what shift they actually attended in the first academic year and the cause of assignment to that shift. Available choices for the latter were "lottery draft", "I had relatives in the school attending that same shift", "merit", "I was wait-listed and eventually admitted to the evening shift", and "other". This last question served as a double check for the consistency between reported participation in the lottery and cause of shift assignment. Last, students were asked if they had moved to another shift and if so, in which academic year.

To gather pre-treatment characteristics we asked students about age, gender, characteristics of the primary school they attended, and the education of their parents. To measure the outcomes of interest, we asked all students about their sexual initiation and current consumption of alcohol and drugs and to female students if they had ever had an abortion. Finally, in order to test for possible mechanisms of the impact of school shift on risky behavior, we asked students about their interaction with their parents and about their nightlife exposure.

2.3 Pilot survey

In April 2010 we administered a pilot survey to test the accuracy of the questions included in the final 2013 survey. In order to avoid contamination between the subjects that would participate in the two surveys, we not only performed the pilot survey sufficiently before the 2013 survey (more than three years before) but also, and critically, we aimed the pilot survey to the set of students that were already graduated from the school. That is, in 2010 we distributed the survey among former students that graduated from the school between 1983 and 2009. Given this design, it is extremely unlikely that subjects in the 2013 survey were aware of the existence or contents of the survey beforehand.

The pilot survey included the same questions as the final survey on treatment, outcomes, and pre-treatment characteristics. It was released by e-mail by the ESCCP Office of Graduate Students to all the school graduates. Given this way of distributing the survey, the low response rate ended up being a big concern. In effect, the pilot survey was answered by 405 former students that graduated between 1983 and 2009, approximately 4% of the total graduates in these cohorts.

In spite of the low response rate, a convenient feature of the pilot survey is that it allows us to measure sexual behavior and substance consumption of graduates in the long run. That is, in this pilot survey adults between 18 and 46 years old respond questions on shift attended at high school back when they were adolescents and their attitudes towards sex and substance consumption later in life. Hence, a nice by-product of the data gathered through this pilot survey is that it allows us to evaluate the impact of high school shift on the outcomes of interest in the long run. At the same time, the pilot survey provides external validity to our main research, by allowing for the study of the effects of interest on cohorts other than the 2013 cohort.

3 Summary statistics and randomization check

In this section we describe the 2013 cohort data and present evidence supporting the validity of the random assignment. We consider the potential problems associated to attrition, non-compliance, and treatment-control balance and we conclude that non of them are likely to undermine the main results of the paper. The evidence presented in this section is displayed in table 1. Table 1 presents summary statistics and balancing tests for an attrition indicator, shift attended, pre-treatment characteristics, and outcomes, for the 2013 cohort. We exclude from the analysis students that were exempt from the shift assignment lottery since our empirical strategy is based on the random assignment of shift. The final sample consists of the 263 fifth year students (164 males and 99 females) that answered the survey and were assigned their shift through the public lottery.

3.1 Variables used in the paper

In table 1 *Control* refers to the set of students that was assigned either the morning shift or the afternoon shift in the lottery session and *Treatment* refers to the set of students that was assigned the evening shift in the lottery session. For each variable in the table, the second column shows the total amount of observations, the following three columns display descriptive statistics of the control group, and the last two columns show the test of differences in means between treatment and control group characteristics. Because our sample is small, lack of power in detecting significant differences between treatment and control characteristics might be a concern. Hence, after showing the mean difference in variables, in the last column of the table we show 90% bootstrapped confidence intervals for the tests of differences in means. We describe the variables included in the table next.

Not surveyed is a dummy variable that takes value one if the student did not answer the survey (either because of refusal or absenteeism from school on the day of our visit) and zero otherwise. *High School at Night*, is our *treatment received* variable and is the percent of academic years the student attended the evening shift. Pre-treatment characteristics are *Primary school full time*, *morning*, or *afternoon* (three dummy variables that take value one if the student attended the primary school full time, in the morning shift, or in the afternoon shift, respectively); *Primary school public* (a dummy variable that takes value one if the student attended the primary school at a public institution); *Birthyear* (the year the student was born); *Parents have higher education* (a dummy variable that takes value one if at least one of the student's parents went to college); and *Female* (a dummy variable that takes value one if the student is a female).

The outcomes are described next. Sexual outcomes include *Sexual initiation* (a dummy variable that takes value one if the student reports having ever had sex) and *Abortion* (a dummy variable that was only measured on females and that takes value one if the girl reports having ever got an abortion). To measure consumption of substances we first construct two dummy variables, *Drugs* (a dummy that takes value one if the student reports that in a typical week (s)he consumes marijuana, cocaine, other hallucinogenic substances, or smokes) and *Alcohol* (a dummy that takes value one if the student reports that in a typical week (s)he consumes alcoholic drinks, like beer, wine, white spirits, and bitters). Then, we construct the variable *Principal component* (reported

in the table) that captures the first principal component of the raw measures of consumption of substances.

3.2 Attrition

We only observe the characteristics of fifth year students that answered the survey. Hence, attrition (that is, the disappearance of a student from our sample between the time of the lottery assignment and the date of the survey) might undermine the exogeneity of the random assignment. In this subsection we consider two sources of attrition: dropping out from school before the fifth year and not answering the survey when still enrolled at ESCCP by the day of our visit.

For this cohort, administrative data reveals that drop-out rates (that is, abandoning the school between the lottery assignment and graduation date) are extremely low. First, in this cohort there was no incoming student that rejected admission after knowing the shift assigned by the lottery. Second, failing rates are extremely low and orthogonal to shift assignment.[5]

Finally, attrition due to non-response rates is low and orthogonal to treatment assignment. The first line in table 1 shows that the percent of students who attend the fifth year and were not surveyed is 19.5% in the control group. This figure is 2% higher than the corresponding figure in the treatment group, but the difference is not statistically significant at the standard levels.

All things considered, we conclude that attrition is unlikely to have undermined the validity of the randomization or to bias the main results of the paper.

3.3 Non-compliance

Another potential source of bias is non-compliance, that is, attending a shift different from the one assigned by the lottery. Table 1 reveals that compliance in our sample is extremely high: students randomized into the night shift are 90% more likely to attend the night shift relative to students randomized into daytime shifts. The difference is significant at a 1% level. Even when compliance in our sample is high, in our empirical strategy we correct for the potential non-compliance bias by instrumenting treatment received with treatment assigned (see section 4 for details).

3.4 Treatment-control balance

To complete the randomization check, we perform a set of tests of the null hypothesis that pre-treatment characteristics predict the lottery assignment. Firstly, we run a regression of randomized shift on the set of pre-treatment characteristics and perform a test of joint significance (not reported). Pre-treatment characteristics are not jointly significant to explain randomization status, with a p-value of the joint F-test of 0.327. We, additionally, report tests of balancing of pre-treatment characteristics by treatment status. In general pre-treatment characteristics are balanced between treatment and control groups and the tests are highly robust to bootstrap correction for lack of power due to small sample. The only exception is *Female*. The test indicates

[5]ESCCP rules indicate that when a student fails a course she must leave the school. However, given the selection process, there almost no failing students.

that being randomized into the evening shift is associated with a lower probability of being a female relative to being randomized into daytime shifts. Even though the effect is not too big, we would worry that less risky girls change their shift or drop out from the school after knowing that they were assigned to the night shift. Based on the evidence presented in the two previous subsections, there is no differential attrition of females across treatments so we conclude that the higher male-to-female ratio in the treatment group is not due to non-random attrition (on the contrary, we showed evidence that attrition due to non-response rates is higher in the control group). Moreover, in our instrumental variables estimation we will control for the non-compliance bias. Finally, in all specifications below we control for gender.

To conclude, the random assignment of school shift, the insignificance of attrition and non-compliance, and the balancing of pre-treatment characteristics indicate that the results presented below are not subject to significant sources of selection bias.

3.5 Pilot survey analysis

In appendix A we present the same summary statistics and balancing for the data obtained through the pilot survey. The only difference between the two surveys is our measure of sexual initiation. Given that the pilot survey targets adults, we asked graduates about their age at first time to have intercourse (variable *Age at sexual initiation*) instead of whether or not they initiated.

As explained in section 2, for the 1983-2009 cohorts we are unable to perform attrition analysis. In spite of this, the post attrition sample exhibits high compliance and balancing of pre-treatment characteristics, as evidenced in table 9. Compliance among respondents is lower than for the 2013 cohort but still high, and most pre-treatment characteristics are balanced (with the exception of *Parents have higher education*. Because of the low response rate, nevertheless, we are cautious about interpretation of results from the pilot survey and take them as a robustness check.

4 Empirical strategy

The last three lines of table 1 suggest that being randomized into the night shift affects the probability of getting an abortion: females in the evening shift are 8% more likely to get an abortion than females in daytime shifts. In the whole sample of students, there is no difference in sexual initiation and substance consumption between students across shifts. To deep further into these findings, in our preferred specifications we analyze heterogeneous treatment effects by gender. In section 6, where we analyze the mechanisms for the main results of the paper, we present evidence that supports an explanation of differential parental supervision for daughters and sons. The idea is based on two assumptions: (i) that parents care more about the sexual behavior of girls compared to the sexual behavior of boys and (ii) that having a kid going to school at night increases the cost of parental supervision. According to this explanation, the increase in the cost of parental control should have a greater effect on the sexual behavior of girls relative to boys. Our findings are consistent with this story and

justify analyzing the impacts for males and females separately.

4.1 Estimation

The main objective is to identify the causal relationship between studying at night and adolescents' attitudes towards sex and substances by gender. Formally, the impact of attending high school at night on risky behavior is captured by estimating the following equation:

$$RiskBehavior_{ig} = \beta + \delta Evening_i + \gamma X_{ig} + \epsilon_{ig} \quad (1)$$

where $RiskBehavior_{ig}$ is any of the outcomes of interest for student i of gender g; $Evening_i$ is a continuous variable that captures the percent of academic years the student attended the evening shift; δ is the casual reduced form parameter of interest; X_{ig} is the matrix of student i pre- treatment characteristics described in table 1; and ϵ_{ig} is an individual level random error term assumed to be uncorrelated with $Evening_i$.

Evening is potentially endogenous in model (1). Adolescents with higher propensity to engage in unsafe sex or consuming substances might have a preference for night life or for having less parental control and, therefore, might self-select into the evening shift. The natural experiment described in section 2 provides for a source of exogenous variation for *Evening* given that in our sample high school shift is randomly assigned. However, as shown in section 3, compliance with the lottery assignment is not perfect. To account for the presence of non-compliance, we use the randomly assigned shift as an instrument for the shift actually attended. As shown in Angrist *et al.* (1996), the Two Stages Least Squares (2SLS) estimator recovers the Local Average Treatment Effect (LATE), a parameter that estimates the effect of shift attended on those students whose shift attended is influenced by the lottery assignment. Our estimation strategy is, hence, twofold. Fist, we estimate the Intention to Treat (ITT) parameter by estimating δ in equation (1) by Ordinary Least Squares (OLS) when $Evening_i$ is specified as the school shift assigned to student i by lottery. Second, we estimate the LATE parameter by estimating δ in equation (1) by 2SLS when $Evening_i$ is specified as the school shift that student i actually attended and it is instrumented with the shift assigned through the lottery. The first stage of the 2SLS approach is very strong as evidenced in table 2. This table reports the OLS estimates from a regression of *High School at Night* on *Randomized into the Night* (our instrumental variable, a dummy that takes value one if the student was assigned to the night shift thorough the lottery) and pre-treatment characteristics as covariates in column (2). The estimates of the first stage suggest that students that have been randomized into the night are 90% more likely to attend the night shift relative to their peers in the daytime shifts and the effect is highly significant.

4.2 Inference

To test for the significance of the parameters estimated, we pursue two strategies. First, given that we are dealing with a small sample, we bootstrap confidence intervals for the parameters of interest. Second, given that for outcomes *Sexual initiation* and *Substance consumption* we analyze the *Evening* effect separately for

males and females we additionally perform joint tests of the hypotheses across gender following the Romano & Wolf (2005) step-down procedure. We do this because when we split the sample by gender, the number of hypothesis being tested increase, which raises the concern of increasing the Family Wise Error (FWE), that is, of detecting significant effects in some of the hypothesis due to mere chance.[6]

5 Results

Tables 3 to 5 show the main results of this paper: the estimation of equation (1) for all the outcomes of interest, by gender.

All tables have the same structure. Models (1) to (4) correspond to the estimates on the sub-sample of females, while models (5) to (8) report results for males. Moreover, specifications (1), (2), (5), and (6) report the estimates of the ITT parameter, while specifications (3), (4), (7), and (8) report the estimates of the LATE parameter. Finally, specifications (2), (3), (6), and (8) include pre-treatment characteristics as covariates. Within each model, the first line shows the magnitude of the estimates of the *Evening* effect and the second line shows 90% bootstrapped confidence intervals. Given that many effects are significant with a confidence level different than 90% we also indicate significance levels with stars.

5.1 Main results: the short run impact of going to school at night

Tables 3 and 4 show the estimations of the effect of going to school at night on the sexual behavior of teenage girls and boys. The results suggest that girls that attend the evening shift are between 17% and 21% more likely to have initiated sexually by the age of 18 relative to girls going to school at daytime. These effects are significant at the 10% level in the models that include covariates and marginally significant in the models that do not include covariates (the p-value is less than 0.13). Furthermore, girls going to high school at night are between 7.5% and 8.5% more likely to have got an abortion relative to girls attending school during the day. These effects are significant at the 10% level in all specifications.

For males we can only measure sexual initiation given that boys might be unaware of a terminated pregnancy by a sexual partner. Results for boys suggest an opposite effect than for girls: boys attending the evening shift are between 16% and 20% less likely to have initiated sexually relative to boys attending the daytime shifts. The effects are significant at the 5% level.

For the sexual initiation outcome, we test jointly the hypotheses that the effects for females are positive and that the effects for males are negative.[7] The Romano & Wolf (2005) test suggests that all effects are jointly significant (p-values for females are less than 0.11 and for males are between 0.4 and 0.5). The positive result of the joint test provides evidence that it is not because of mere chance that we are able to detect significant evening effects when we split the sample between females and males: the effects continue to be significant even

[6] Formally, Romano & Wolf (2005) define the FWE as the probability of falsely rejecting a proportion $\frac{\alpha}{n}$ of true hypothesis when testing simultaneously a family of n hypothesis, each at level α.

[7] We also perform the Romano-Wolf two sided joint tests, but we loose some power due to the small amount of observations and the high amount of hypotheses being tested jointly: while the effects for males continue to be significant, we fail to detect a significant effect for females in the two sided test.

when we control for the FWE. In turn, this suggests that the lack of effect in the sample that pools girls and boys, as shown in table 1, is due to the fact that girls and boys exhibit opposite effects, as shown in this table 3.

Table 5 shows the estimation the impact of going to school at night on substance consumption as measured by the first principal component of the consumption of drugs and alcohol.[8] We are not able to detect any significant effect of attending the evening shift on substance consumption, which suggests that females and males going to school at night are equally likely to consume substances relative to their peers going to school at daytime.

To sum up, our main estimates suggest that teenage girls going to school at night take more risks than girls going to school at daytime when it comes to sexual behavior. Girls in the evening shift are more likely to have started having sex by the age of 18 and are more likely to have terminated a pregnancy during adolescence. On the contrary, boys in the evening shift seem to be less sexually risky than boys in the daytime shifts. Finally, for both girls and boys there is no difference between students going to school at different shifts on substance consumption.

5.2 Robustness check: long run effects

A potential concern about the analysis in the previous subsection could be that the effects found are specific to the 2013 cohort. We present evidence that the main results of the paper, namely the effect of the evening shift on the sexual behavior of girls, are not specific to this particular cohort by describing the results obtained for the pool of the 1983-2009 cohorts of graduate students that participated in our pilot survey.

Results for all outcomes are presented in table 6. The main difference between the structure of this table and the tables presented in the previous section is that in table 6, to save space, we only present the specifications that include covariates. Columns (1) to (4) present the estimations for sex initiation, columns (5) and (6) for abortion, and columns (7) to (10) for substance consumption. Since in these regressions we are pooling graduates from different cohorts, we include cohort fixed effects in all specifications.

Comparing tables 6 and the main tables of the paper (tables 3 to 5) we observe that females in the 2013 cohort follow the same patterns as females in the 1983 to 2009 cohorts. In the cohorts of graduates, females that attended the evening shift started to have sex about one year old younger than females in the daytime shifts. Moreover, women that went to high school at night are between 14% and 20% more likely to have got an abortion relative to females that attended school during the day. in addition, the results for the cohorts of graduates suggest that there is no impact of going to school at night on substance consumption for females. These results suggest that even after graduation from high school the sexual behavior of females that were more exposed to night-time hours during adolescence is riskier than the sexual behavior of females that attended high school during the day. However, again, the low response rates are a concern when it comes to interpreting the magnitude of these effects, and this interpretation should be taken with care and just as a robustness check.

[8]The first principal component explains more than 75% of the total variability in substance consumption. We choose to collapse all measures of consumption in the principal component as another way of controlling the FWE, since otherwise we would be testing a high amount of hypothesis (one for each substance).

For males the results on sexual behavior for the 2013 cohort do not seem consistent with the long run effects. Contrary to the 2013 cohort evidence that males in the evening shift are less likely to start having sex by the age of 18, when we consider the long run table 6 suggests that graduate males that attended high school at night started to have sex at the same age as graduate males that went to high school at daytime.

5.3 Preliminary conclusions

To conclude, the evidence on sexual behavior suggests a clear pattern for girls and an indefinite pattern for males. Attending high school at night causes riskier sexual behavior of females during adolescence and after graduation. On the contrary, attending high school at night seems to postpone sexual initiation for boys in high school, but this effect vanishes when we consider the long run. In addition, there is no difference between individuals attending high school at night and individuals attending high school at daytime when it comes to substance consumption. This is true for the short run and the long run, and for males and females.

6 Mechanisms: parental supervision

The finding of riskier sexual behavior for girls going to school at night but not for boys, and of no differential behavior in consumption of substances across shifts and gender motivates the exploration of the mechanisms that explain these particular patterns. In this section we argue that the night-shift effects found in this paper are due to the differential exposure of girls and boys to parental control.

6.1 A model of differential parental supervision across genders

Consider a simple choice model of a family composed by teenage children and parents. Teenagers, on the one hand, extract utility from engaging in risky behavior such as having unprotected sex or consuming substances. Parents, on the other hand, care for the integrity of their children so they split their time between working, leisure, and supervising their children in order to avoid them from engaging into risky behavior.

Suppose, firstly, that teenagers that go to school at night share less time with their parents.[9]

Suppose, secondly, that parents care equally for the health or quality of their children, irrespective of their gender, but that they care more for the sexual behavior of their daughters relative to their sons.[10]

The problem of teenagers is to maximize their risky behavior consumption subject to a parental supervision constraint.

The predictions from this simple model are clear. The first assumption implies that teenagers going to school at night face a more relaxed constraint for risky behavior relative to teenagers going to school at daytime. This would predict an increase in the risky behavior of all students going to school at night, unless the budget constraint is non-binding.

[9]For example, because when students are at home during the day their parents are at work, and when students are at school in the evening, their parents return home from work.

[10]For example, because parents also care for the quality of their grand children that are claimed with probability one if the grand children are the kids of their daughters but with probability $p < 1$ if their grand children are the kids of their sons.

The second assumption implies that the budget constraint for risky behavior is more binding for girls than for boys. This would predict that a reduction in parental supervision would affect girls more than boys.

This simple model explains the pattern of results found here. First, girls going to school at night take more sexual risks than girls going to school at daytime, consistent with the model prediction that the constraint for risky behavior is more relaxed for students going to school at night. Second, the clear positive effect of the night shift on risky sexual behavior for girls, together with the indeterminate pattern for boys, is consistent with the model prediction that the budget constraint for risky sexual behavior is more binding for girls than for boys. Third, we do not detect conclusive differences in the signs of the night shift on substance consumption between males and females: tables 5 and 6 suggest that females in the night shift are riskier and that males in the night shift become riskier as they age. This would be implied by the second assumption of the model, according to which parents have the same preferences for the health or quality of their daughters and sons. Contrary to the predictions of this model, however, we fail to find a significant positive effect of going to school at night on substance consumption. Finally, we are able to empirically reject other possible mechanisms that would not explain the patterns we found in the data because, for example, they would not predict any differential behavior across genders.[11]

To sum up, if parental supervision is systematically higher for kids going to school at daytime, and if parents do not supervise their sons as much as they supervise their daughters, we would expect that the relaxation of the budget constraint for risky behavior caused by attending the evening shift would impact girls but not boys. This is exactly what we find.

In order to validate empirically the mechanism proposed, we provide empirical evidence for the assumptions of the model.

6.2 Time with parents

In table 7 we provide evidence that students going to school at night (irrespective or their gender) face a more relaxed constraint for risky behavior relative to students going to school at daytime. We proxy the constraint for risky behavior as the potential time under the supervision of parents. We construct this measure as the percent of a typical day in which a student is not attending school and at least one of his or her parents is not at work.[12] Of course this measure is *potential* because we cannot observe if when both parents and students are out of work or school they are in fact together at home. Our evidence, thus, provides an upper bound on the association between high school shift and time under parental supervision. Table 7 suggests that students going to school at night are (at most) around 20% less likely to be at home with their parents relative to students going to school at daytime. It is worth clarifying that non of these effects are intended to be interpreted as the causal effects of the school shift on parental supervision, given that parents have the possibility of adjusting

[11] We explored the mechanisms of within classroom peer effects, family and friendship influences, and exposure to nightlife and we were unable to find significant differences across shifts or gender. Students going to school at night are equally likely to go out at night, to share meals with their family, and to have friends or family members engaged in consumption of substances, relative to students going to school at daytime; moreover, we did not detect differential classroom peer effects or differential quality of education across shifts. The estimates of these effects are available from the authors upon request.

[12] In the main survey for cohort 2013 we asked students to report the work time schedule of their father and mother.

their time use and labor supply after learning their kids' school shift.[13] All we can conclude from these results is that going to school at night is associated with lower overlap of students with their parents. This evidence, thus, provides some support to the claim that the constraint for risky behavior (proxied by parental supervision) is more relaxed for students going to school at night relative to students going to school at daytime. This, in turn, operates as a mechanism through which students going to school at night are more likely to engage in risky behavior.

6.3 Differential parental care by gender

Here we explore if the parental supervision constraint for girls is more binding than for boys. First, there is an important body of literature indicating that parents care more about the sexual behavior of daughters than of sons. Nagamatsu *et al.* (2008) present evidence that parental monitoring was statistically associated with delay of first intercourse in female students. Wamoyi *et al.* (2011) find that girls receive more supervision in issues related to sexual behavior compared to boys. In line with our explanation, they report evidence that parents spending little time with their children precludes parents to effectively monitor their children. Rani *et al.* (2003) report that girls were more often discouraged by parents or siblings from engaging in sex, while boys were, on the contrary, encouraged by family to engage in premarital sex.[14]

Second, we are able to provide some empirical support to this hypothesis. We asked students the frequency they have conversations with their parents on important aspects of their lives. If we accept that this variable is a proxy for parental care or concern, table 8 suggests that being a female student is associated with higher parental concern with respect to boys. This is the case for the whole sample and for the control and treatment groups separately. Interestingly, although students at night talk less frequently with their parents (the mean value for males in the treatment group is less than for males in the control group), parents of girls attending school at night talk to their daughters much more frequently than parents of boys in the night shift in comparison to the behavior of parents of kids going to school at daytime. This could be interpreted as an attempt of parents of girls going to school at night to overcompensate for the lower time they spend together with their daughters, which provides further support for the hypothesis of differential concern of parents between sons and daughter.

7 Concluding remarks

Understanding the factors that lead adolescents to engage in risky behavior such as having unsafe sex or consuming substances is important from a policy perspective and it is also a high research priority. Our paper contributes to these academic and policy debates by providing evidence on the link between the shift attended during high school and risky behavior.

Our main finding is that girls attending high school in the evening start having sex at an earlier age

[13] If parents of kids going to school at daytime adjust their labor supply systematically different relative to parents of kids going to school at night the effects observed are subject to omitted variables bias.

[14] Note that the fact that boys are encouraged by parents to gain sexual experience is consistent with the negative sign found in the short run for boys: boys going to school at night that are less exposed to interaction with their parents start having sex later than boys going to school at daytime.

and present a higher probability of getting an abortion. Results are not only statistically significant but quantitatively relevant. Girls attending the evening shift are between 17% and 21% more likely to have initiated sexually by the age of 18 relative to girls going to school at daytime. In addition, girls attending high school at night are around 8% more likely to have got an abortion relative to girls attending school during the day. Results hold when we use an alternative sample of alumni.

The random assignment of shifts, the presence of very few non compliers, and the fact that in our sample there are no students that have rejected an offer to study regardless of the shift assigned, suggest that the link between high school shift and risky behavior is causal.

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Table 1: Summary statistics and randomization check

		Control Group			Treatment - Control	
Variable	*Obs.*	*Obs.*	*Mean*	*Std.Dev.*	E(1)-E(0)	
Attrition:						
Not surveyed	324	215	0.195	0.397	-0.021	[-0.096;0.054]
Treatment:						
High School at Night	263	173	0.002	0.030	0.902***	[0.855;0.950]
Pre-treatment characteristics:						
Primary school full time	262	173	0.503	0.501	0.081	[-0.023;0.190]
Primary school morning	262	173	0.358	0.481	-0.033	[-0.135;0.070]
Primary school afternoon	262	173	0.139	0.347	-0.049	[-0.118;0.021]
Primary school public	263	173	0.515	0.501	-0.037	[-0.148;0.075]
Birth year	262	173	1995	0.778	-0.050	[-0.230;0.131]
Parents have higher education	263	173	0.896	0.306	0.015	[-0.049;0.080]
Female	263	173	0.422	0.495	-0.133**	[-0.231;-0.035]
Outcomes:						
Sexual initiation	263	173	0.486	0.501	-0.086	[-0.194;0.023]
Abortion	98	73	0.00	0.00	0.08*	[0.010;0.150]
Principal Component (substances)	257	170	0.026	1.208	-0.077	[-0.346;0.192]

Notes: The *Control Group* is the set of students that were assigned to the morning or afternoon shift by the lottery assignment. *High School at Night* is a variable indicating the percent of academic years the student attended the night shift. *Primary school full time*, *morning*, or *afternoon* are three dummy variables that take value one if the student attended the primary school full time, in the morning shift, or in the afternoon shift, respectively. *Primary school public* is a dummy variable that takes value one if the student attended the primary school at a public institution. *Birthyear* is the year the student was born. *Parents have higher education* is a dummy variable that takes value one if at least one of the student's parents went to college. *Female* is a dummy variable that takes value one if the student is a female. *Sexual initiation* is a dummy variable that takes value one if the student reports having ever had sex. *Abortion* is a dummy variable that takes value one if the student reports having got an abortion and has been measured on the subsample of females. *Substance index* is the simple average of the standardized measures of consumption of substances, where the standarization was made by subtracting the control group mean and dividing by the control group standard deviation of each measure of consumption. *Principal component* is the principal component of the raw measures of consumption of substances. Measures of consumption of substances are *Drugs* (a dummy that takes value one if the student reports that in a typical week (s)he consumes marijuana, cocaine, other hallucinogenic substances, or smokes) and *Alcohol* (a dummy that takes value one if the student reports that in a typical week (s)he consumes alcoholic drinks, like beer, wine, white spirits, and bitters). The last column of the table reports the results of a test of differences in means by lottery status. Bootstrapped 90% confidence intervals are shown in square brackets.***Variable different from zero with a confidence level of 99%. **Variable different from zero with a confidence level of 95%. *Variable different from zero with a confidence level of 90%.

Table 2: First Stage

	High School at Night	
	(1)	(2)
Randomized into the Night	0.902***	0.903***
	[0.855;0.949]	[0.856;0.950]
Observations	263	261
Covariates	No	Yes

Notes: The dependent variable, *High School at Night*, is the percent of academic years the student attended the evening shift. *Randomized into the Night* is a dummy variable that takes value one if the student was assigned to the night shift thorough the lottery. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; *Parents have higher education*; and *Female*. Bootstrapped 90% confidence intervals are shown in square brackets. ***Variable different from zero with a confidence level of 99%.

Table 3: Probability of Sexual Initiation

			Females	
	(1)	(2)	(3)	(4)
Randomized into the Night	0.172	0.200*		
	[-0.012;0.355]	[0.010;0.390]		
High School at Night			0.183	0.213*
			[-0.015;0.382]	[0.004;0.423]
Control Group Mean			0.521	
Observations	99	99	99	99
			Males	
	(5)	(6)	(7)	(8)
Randomized into the Night	-0.179**	-0.158**		
	[-0.307;-0.051]	[-0.295;-0.022]		
High School at Night			-0.202**	-0.179**
			[-0.343;-0.060]	[-0.333;-0.026]
Control Group Mean			0.460	
Observations	164	162	164	162
Covariates	No	Yes	No	Yes

Notes: The dependent variable is *Sexual Initiation*. In columns (3), (4), (7), and (8) we instrument *High School at Night* with *Randomized into the Night*. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; and *Parents have higher education*. Bootstrapped 90% confidence intervals are shown in square brackets. **Variable different from zero with a confidence level of 95%. *Variable different from zero with a confidence level of 90%.

Table 4: Probability of Abortion (females)

	(1)	(2)	(3)	(4)
Randomized into the Night	0.080*	0.076*		
	[0.009;0.151]	[0.005;0.147]		
High School at Night			0.085*	0.081*
			[0.008;0.163]	[0.005;0.157]
Control Group Mean			0	
Observations	98	98	98	98
Covariates	No	Yes	No	Yes

Notes: The dependent variable is *Abortion*. In columns (3) and (4) we instrument *High School at Night* with *Randomized into the Night*. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; and *Parents have higher education*. Bootstrapped 90% confidence intervals are shown in square brackets. *Variable different from zero with a confidence level of 90%.

Table 5: Principal component of substance consumption

			Females	
	(1)	(2)	(3)	(4)
Randomized into the Night	0.181	0.153		
	[-0.292;0.654]	[-0.354;0.661]		
High School at Night			0.193	0.164
			[-0.309;0.695]	[-0.361;0.689]
Control Group Mean			0.004	
Observations	97	97	97	97
			Males	
	(5)	(6)	(7)	(8)
Randomized into the Night	-0.189	-0.216		
	[-0.530;0.153]	[-0.560;0.129]		
High School at Night			-0.213	-0.246
			[-0.600;0.173]	[-0.641;0.150]
Control Group Mean			0.042	
Observations	160	158	160	158
Covariates	No	Yes	No	Yes

Notes: The dependent variable is the first principal component of the measures of substance consumption. In columns (3), (4), (7), and (8) we instrument *High School at Night* with *Randomized into the Night*. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; and *Parents have higher education*. Bootstrapped 90% confidence intervals are shown in square brackets.

Table 6: 1983-2009 cohorts outcomes

	Age at sex initiation		***Abortion***		***Principal component (substances)***	
			Females			
	(1)	(2)	(5)	(6)	(7)	(8)
Randomized into the Night	-0.773*		0.142**		0.114	
	[-1.529;-0.017]		[0.048;0.236]		[-0.268;0.496]	
High School at Night		-1.019*		0.202**		0.164
		[-1.97;-0.069]		[0.064;0.341]		[-0.368;0.696]
Control Group Mean	17.776		0.054		-0.150	
Observations	141	141	163	163	164	164
			Males			
	(3)	(4)			(9)	(10)
Randomized into the Night	0.065		n.a.		0.241	
	[-0.608;0.738]		n.a.		[-0.217;0.698]	
High School at Night		0.097		n.a.		0.361
		[-0.887;1.08]		n.a.		[-0.367;1.089]
Control Group Mean	17.197		n.a.		0.174	
Observations	122	122	n.a.	n.a.	131	130

Notes: The dependent variables are the age at sex initiation in columns (1) to (4), *Abortion* in columns (5) and (6), and the first principal component of the measures of substance consumption in columns (7) to (10). In columns (2), (4), (6), (8), and (10) we instrument *High School at Night* with *Randomized into the Night*. All specifications include covariates. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; and *Parents have higher education*. All regressions include cohort fixed effects. Bootstrapped 90% confidence intervals are shown in square brackets. **Variable different from zero with a confidence level of 95%. *Variable different from zero with a confidence level of 90%.

Table 7: Potential percent of day at home with parents

	(1)	(2)	(3)	(4)
Randomized into the Night	-0.191***	-0.195***		
	[-0.244;-0.138]	[-0.248;-0.143]		
High School at Night			-0.212***	-0.216***
			[-0.268;-0.156]	[-0.273;-0.160]
Control Group Mean			0.435	
Observations	263	261	263	261
Covariates	No	Yes	No	Yes

Notes: The dependent variable is *the percent of a typical day in which a student is not attending school and at least one of their parents is not at work.* In columns (3) and (4) we instrument *High School at Night* with *Randomized into the Night.* Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; *Parents have higher education*; and *Female.* Bootstrapped 90% confidence intervals are shown in square brackets. ***Variable different from zero with a confidence level of 99%.

Table 8: Probability of talking frequently with parents about personal matters

	All		***Control group***		***Treatment Group***	
	(1)	(2)	(5)	(6)	(7)	(8)
Female	0.265***	0.240***	0.216***	0.194**	0.373***	0.378***
	[0.165;0.364]	[0.138;0.342]	[0.071;0.360]	[0.050;0.338]	[0.104;0.642]	[0.076;0.680]
Mean of males	0.317		0.340		0.281	
Observations	262	260	172	172	90	88
Covariates	No	Yes	No	Yes	No	Yes

Notes: The dependent variable is *talks frequently*, a dummy variable that takes value one if the student reports talking always or with high frequency with their family about personal matters and zero if the student talks almost never or never with their parents. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; and *Parents have higher education*. Bootstrapped 90% confidence intervals are shown in square brackets. ***Variable different from zero with a confidence level of 99%. **Variable different from zero with a confidence level of 95%.

Appendix A 1983-2009 cohorts: summary statistics, balancing, and first stage

Note: Effects in this table are different from first columns in outcome tables because in outcome tables we report regressions with cohort fixed effects.

Table 9: 1983-2009 cohorts: Summary statistics and randomization check

		Control Group			Treatment - Control	
Variable	*Obs.*	*Obs.*	*Mean*	*Std.Dev.*	E(1)-E(0)	
Treatment:						
High School at Night	299	199	0.007	0.074	0.679***	[0.606;0.752]
Pre-treatment characteristics:						
Primary school full time	298	200	0.350	0.478	0.099	[0.000;0.198]
Primary school morning	298	200	0.455	0.499	-0.067	[-0.169;0.035]
Primary school afternoon	298	200	0.195	0.397	-0.032	[-0.110;0.047]
Primary school public	299	200	0.595	0.492	-0.060	[-0.161;0.042]
Birth year	300	200	1981.74	7.433	-0.820	[-2.270;0.630]
Parents have higher education	300	200	0.885	0.320	-0.085	[-0.162;-0.008]
Female	300	200	0.57	0.496	-0.050	[-0.153;0.053]
Outcomes:						
Age at sexual initiation	264	179	17.514	2.247	-0.361	[-0.780;0.058]
Abortion (females)	163	112	0.054	0.226	0.123**	[0.020;0.226]
Substance index	296	199	0.000	0.830	0.027	[-0.158;0.212]
Principal Component (substances)	296	199	-0.011	1.162	0.035	[-0.225;0.294]

Notes: The *Control Group* is the set of graduates that were assigned to the morning or afternoon shift by the lottery assignment. *High School at Night* is a variable indicating the percent of academic years the graduate attended the night shift at high school. *Primary school full time*, *morning*, or *afternoon* are three dummy variables that take value one if the graduate attended the primary school full time, in the morning shift, or in the afternoon shift, respectively. *Primary school public* is a dummy variable that takes value one if the graduate attended the primary school at a public institution. *Birthyear* is the year the graduate was born. *Parents have higher education* is a dummy variable that takes value one if at least one of the graduate's parents went to college. *Female* is a dummy variable that takes value one if the graduate is a female. *Age at sexual initiation* is the at which the graduate had sexual intercourse for the first time. *Abortion* is a dummy variable that takes value one if the graduate reports having got an abortion and has been measured on the subsample of females. *Substance index* is the simple average of the standardized measures of consumption of substances, where the standarization was made by subtracting the control group mean and dividing by the control group standard deviation of each measure of consumption. *Principal component* is the principal component of the raw measures of consumption of substances. Measures of consumption of substances are *Drugs* (a dummy that takes value one if the graduate reports that in a typical week (s)he consumes marijuana, cocaine, other hallucinogenic substances, or smokes) and *Alcohol* (a dummy that takes value one if the graduate reports that in a typical week (s)he consumes alcoholic drinks, like beer, wine, white spirits, and bitters). The last column of the table reports the results of a test of differences in means by lottery status. Bootstrapped 90% confidence intervals are shown in square brackets.***Variable different from zero with a confidence level of 99%. **Variable different from zero with a confidence level of 95%.

Table 10: 1983-2009 cohorts: First Stage

	High School at Night	
	(1)	(2)
Randomized into the Night	0.668***	0.666***
	[0.593;0.744]	[0.587;0.744]
Observations	299	297
Covariates	No	Yes

Notes: The dependent variable, *High School at Night*, is the percent of academic years the student attended the evening shift. *Randomized into the Night* is a dummy variable that takes value one if the student was assigned to the night shift thorough the lottery. Covariates are *Primary school full time*, *morning*, or *afternoon*; *Primary school public*; *Birthyear*; *Parents have higher education*; and *Female*. All regressions include cohort fixed effects. Bootstrapped 90% confidence intervals are shown in square brackets. ***Variable different from zero with a confidence level of 99%.