Wheeling into school and out of crime: Evidence from linking driving licenses to minimum academic requirements*

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Abstract

Since the late 1980s, several U.S. states have set minimum academic requirements for high school students to apply for and retain their driving licenses. These laws popularly known as "No Pass No Drive" (NPND), encourage teenagers with a preference for driving to stay in school beyond the minimum dropout age. Using Federal Bureau of Investigation (FBI) arrest data, we exploit state, time, and cohort variation to show that having an NPND law in place is associated with a significant decrease in arrests due to violent, drug-related and property crime among males between 16 to 18 year of age. We argue that our findings are driven by an increase in education and that NPND laws, when conditioning on academic performance, are a relatively low cost policy that generates positive externalities beyond and in addition to the minimum dropout age.

Keywords: No Pass No Drive Laws; Juvenile Crime; Education.

JEL Classification: K14; J24; J18.

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1 Introduction

The estimated costs of crime account for up to six percent of the U.S. economy (Chalfin, 2015), a similar estimate to education expenditures (UNESCO, 2015). For instance, roughly 11.2 million offenders were arrested in the U.S. in 2014. Estimates of the monetary costs of crime range from around $9,000 for vehicle assaults to up to $8.5 million for murder.[1] More importantly, the proportion of underage perpetrators, specially men is significant. According to the Office of Juvenile Justice and Delinquency Prevention, nearly 20% of individuals arrested for violent crimes and more than 25% arrested for property crimes in 2006 were under the age of 18[2] and boys represented 83% and 68% of juvenile violent and property arrests, respectively.

The vast majority of the traditional labor economics literature focusing on crime analyzes how incapacitation, sanctions, prevention, and improved opportunities in the licit labor market reduce criminal behavior.[3] In recent years, there has been an increased interest in measuring the effects of policies not specifically targeted to reduce crime yet that have an indirect effect on criminal activities. Special attention has been paid to interventions that increase educational quality (Deming 2011; Levitt et al. 2006) or attainment (Machin et. al. 2011, Beatton et al, 2016).[4]

Reducing crime through education can yield significant welfare gains. For instance, higher levels of education are shown to generate further positive externalities through improved health outcomes and good citizenship (Lochner 2011b).

There are several theoretical channels through which education can lead to a decrease in crime. First and foremost, higher education increases expected wages and therefore the opportunity cost of working in licit activities. Second, human capital investments increase patience and the dis-utility of long-term punishments (Becker and Mulligan, 1997). Moreover, more patient individuals are less impulsive and therefore less prone to show an aggressive behavior that can foster crime.[5]

[1] RAND Cost of Crime Calculator.

[2] Violent crime includes murder, rape, robbery, and aggravated assault. Property crime includes burglary, larceny, theft, and arson.

[3] For a review see Freeman (1999).

[4] For a survey of both of these topics see Lochner (2011a).

[5] Psychological literature has also measured a positive correlation between aggressiveness and impulsive-

Third, human capital investments decrease other health risk-taking behaviors such as drinking that are associated with crime (Cutler and Lleras-Muney 2012). Education may also reduce accident rates or Driving Under the Influence (DUI) crimes if more educated individuals have higher discount rates and drive more safely (Harrison, Lau and Williams, 2002). Finally, highly educated individuals are more likely to interact with each other and therefore benefit from positive peer effects. This is key as peer effects have been found to be a very strong determinant of criminal behavior (Patacchini and Zenou 2009).

The aforementioned channels relate to the long-run impacts of education on crime. However, the contemporaneous or short-run impact of schooling on crime is ambiguous. While staying in school longer can have an actual deterrence effect, potential offenders can be incapacitated if they do not have access to criminal activities or are being surveilled or screened while at school. Jacob and Legfren (2003) and Luallen (2006) instrument missing school with teacher in-service and strike days, respectively. Both studies find important incapacitation effects of education on criminal participation because keeping juveniles in school limits their time to commit crime outside school. Nonetheless, violent and unreported crimes such as bullying might increase directly if problematic teenagers are being forced to stay in school and indirectly if they generate a "rotten apple" peer effect (Anderson et. al. 2013).

This paper analyzes the effects of a law commonly known as No Pass, No Drive (NPND) that links access to driving licenses to school attendance and in some cases academic performance. Currently 26 states set minimum academic requirements for teenagers to obtain or retain driving licenses. Using arrests information from the Federal Bureau of Investigation (FBI) and survey data from the Youth Risk Behavior Survey (YRBS), we exploit geographical, time and cohort variation in NPND laws to measure their effects on juvenile crime.

NPND laws have been shown to increase high school graduation rates among males (Barua and Vidal-Fernandez 2014). Moreover, the authors find that NPND laws increase time studying at the expense of leisure and work hours for those teenagers who drop out. Therefore these laws could potentially decrease overall crime. Nonetheless, the net effect of such laws on crime are theoretically ambiguous and both time and location dependent.

ness. An example of this research is Ramirez and Rodriguez (2006).

NPND laws can have a real deterrence effect or just incapacitate potential juvenile criminals if some crimes can not be pursued inside schools. However, these laws could also have a positive effect on unreported in-school crime if it encourages offenders to stay in school without changing their behavior and generate a rotten-apple effect among their peers.

Thus, the net effect of NPND laws will depend on whether the negative effects on crime through increased human capital, incapacitation and deterrence effects are greater than the potential increase in school-related crimes.

Results from the preferred triple-differences specification using FBI data confirm that NPND laws significantly reduce the incidence of all crimes, violent, drug and property crimes only among the affected cohorts of males (16 to 18 year olds). The largest effect is on drug-related crimes among both males and females.

NPND laws not only condition driver licenses on enrollment, but in addition, out of the 26 states with NPND laws, 11 impose additional requirements on behavior or satisfactory academic progress in school. The heterogeneity in the strictness of the law gives us an additional source of variation in the data. Moreover, it allows us to study the differences between conditioning licenses on academic performance versus conduct. To explore crime-related behavior in schools, we analyze microdata from the Youth Risk Behavior Survey (YRBS).[6]

Results from the YRBS suggest that a negative incentive that conditions driver licenses among teenagers on academic progress leads to both lower FBI arrests and lower incidence of within-school crime activities. On the other hand, in states where behavioral restrictions are imposed on students, in-school crime-inducing behaviour is greater but there is no effect on overall arrests.

While the former result is consistent with a externality effect of education driven by linking the license to an increase in performance, the latter shows that linking it to behaviour can actually derive the opposite effect as intended, i.e. encouraging a "rotten-apple"effect.

There are at least four contributions of this paper. First, this is the first paper analyzing

[6]We can not dismiss the possibility that teenagers who do not meet the requirements drive without a license. We unsuccesfully tried to gather information from the National Highway Traffic Safety Administration and individual States Departments of Motor Vehicle on offenses involving driving without a license. Nonetheless, using Fatality Analysis Reporting Data, we do not find any evidence that NPND laws increase accidents involving a fatality (results available upon request to the authors).

the effect on crime of a policy that helps keeping 16 to 18 year olds with a preference for driving, to stay in school beyond the minimum dropout age without forcing them to stay in school. In fact, most of the effects are driven by states that have a compulsory school attendance law that is below 18. Given the evidence that the largest gains from crime reduction come from policies that encourage high school completion (Lochner 2011, and Beatton et. al, 2016), NPND laws seem to be a relatively low-cost policy complementary to compulsory attendance laws.

Second, we find NPND laws to be particularly effective for males, who are not only twice as likely to drop out from high school than females (Department of Education 2014) but also overrepresented among the inmate population.

Third, this paper supports recent evidence that policies aimed at increasing human capital among disadvantaged teenagers might be as cost-effective as early childhood interventions (Fryer 2016).

Fourth, our results are important for education policy as they suggest that negative incentives that condition on academic progress have significant positive externality effects. However, states that impose behavioral restrictions on teenagers have to be cautious as it generates "rotten-apple" effects and may in fact lead to an increase in in-school crime.

2 No Pass No Drive Laws

NPND laws deny or revoke drivers licenses to minors if they drop out of school, are frequent truants and/or have a low academic performance. West Virginia got considerable media attention after being the first state passing such a law in 1988 because it experienced a significant decrease in dropout rates a year after implementation (Ayres 1989). The media attention gave momentum to NPND in the early 90s when most of these laws were enacted.

Table 1 gives the summary of states with NPND laws, the minimum age at which these law apply to students and the maximum age beyond which driving license is no longer conditional on school enrollment.[7] The last column also shows the minimum drop out ages in the NPND states. As we can see, in the vast majority of states, NPND laws constrains students, who

[7]Figure 2 in the Appendix depicts a map summarising Table 1.

care for driving, to stay in school even beyond the minimum compulsory attendance age. Moreover, there are five states that condition on satisfactory progress in school and six states that also require students to comply with behavioral standards in addition to enrollment.

The State Department of Education, the Department of Public Safety and the Division of Driver's Licensing work together towards implementation of NPND. To apply for a driver license, a student is required to show a School Compliance Verification Form to prove that he is compliant with the NPND law. In some states, such as Kentucky and Florida, schools electronically report changes to their students' statuses to the licensing authorities. The online service is provided free of charge and imposes minimal cost to either the state governments or the taxpayers.[8]

When a student is non-compliant, schools are required to notify the Department of Motor Vehicles and Transportation which sends a letter advising the student that he is at risk of losing his driving license unless documentation of compliance is received. The student earns his or her driving privileges back by complying, qualifying for an exemption or waiting until the age of 18 after which the license is no longer conditional on school enrollment. Among the 26 states with an NPND law, 17 condition a driving privileges exclusively upon compliance with school attendance requirements. For the remaining states, satisfactory academic progress and suspension or expulsion from school are additional requisites.

NPND laws have become a popular, statewide carrot-and-stick approach used to address truancy and increase high school graduation rates. Barua and Vidal-Fernandez (2014) show that NPND laws led to a 5.1 percent increase in the probability of graduating from high school among Black males. Further, these laws were effective in reducing truancy and increased time allocated to school-work at the expense of leisure and work.

Unfortunately not all states maintain annual records of the number of licenses that get revoked or are threatened to be revoked due to NPND laws. Nonetheless, informal conversations with some of the state departments suggests that the law is strictly enforced and it can affect a significant proportion of teenage drivers. We contacted the Department of Vehicle Motors in all states and managed to gather only some anecdotal evidence. For instance, in Florida in 2010, out of about 340,000 drivers under 18, the state suspended 5,389

[8]Source: Kentucky Department of Education and Department of Transportation.

student licenses for truancy, and sent warnings to another 24,090 students with a learner's permit who were at risk for a delay in getting their license.[9] Only 4% of those who got their licenses suspended did not meet the requirements to recover their driving privileges in the next period. The proportion of affected teenagers however varies across states. For example, the same year, Georgia suspended 16,000 licenses out of 90,684 drivers under 18, which accounted for approximately 17% of potential teenage drivers affected by NPND laws, while in Tennessee the proportion was around 3% (Southern Regional Education Board, 2011).

Theoretically, the effect of NPND laws on crime is ambiguous and time-dependent. NPND laws can have a real deterrence effect through its effect on education and discount rates or a mere incapacitation effect if certain crimes are not available in school. At the same time, Eckstein and Wolpin (1999) argue that young adults who drop out of high school have lower school ability and/or motivation, place a higher value on leisure and have a lower consumption value of school attendance. Thus, these laws could also have a positive effect on crime if they force marginal students, who are more likely to commit crime, to stay in school. In addition, a potential negative consequence of the law could be that it may encourage teenagers to drive without or fake licenses. This could have high social costs if such drivers are riskier and under-insured.[10] Moreover, students might be willing to falsify documentation to show compliance. Thus, the net effect of NPND laws will depend on the negative effect on crime through increased human capital and the possible path-dependent increase in traffic-related felonies, in-school crime and forgery.

[9]Source: Data tracked by the Florida Department of Motor Vehicles in cooperation with the Florida Department of Education.

[10]This effect can be somewhat mitigated because most states with NPND laws grant exemptions to students who need to work to support their families. Moreover, we have tested this theory using the Fatality Analysis Reporting System (FARS), a dataset on fatal injuries suffered in motor vehicle traffic crashes in the U.S. Negative binomial regression models of the effect of NPND law on state level accident fatalities among teenagers yielded negative but statistically insignificant estimates.

3 Data

3.1 FBI Uniform Crime Reports

To study the effect of NPND laws on crime we use the FBI Uniform Crime Reports (UCR) data from 1988 until 2010. The FBI provides law enforcement agencies with a handbook that explains how to classify and score offenses and provides uniform crime offense definitions across states. The monthly arrests data files gather information on the total number of arrests per 100,000 inhabitants by age, sex, race, and type of crime (murder, rape, property crime, embezzlement, drugs, and driving-related offenses), county and year.[11] Though arrests are not necessarily a true representation of crimes committed, Lochner and Moretti (2004) find high correlations between different types of crimes committed and arrests. For the rest of the analysis, we use crime and arrests interchangeably.

We add up arrests by state and year for two reasons. First, our policy variable changes only at the state and year levels. Second, not all local agencies report the requested information, which introduces measurement error at the agency and/or county level. Therefore, in addition to state and year fixed effects, our models control for state-specific time trends to account for time changes in geographical reporting rates.

We restrict our main analysis to compare NPND affected cohorts (16-18 year olds) with those who are closer in age but should not have been affected (20 to 24 year olds).[12]

Table 2 depicts descriptive statistics of arrests during 1988-2010 by gender and type of crime. The incidence of male arrests among 16 to 18 year olds is particularly high for drug-related crimes, larceny and assault followed by burglary, Driving Under Influence (DUI), motor vehicle thefts and robbery. Among females, the incidence of larceny arrests are highest followed by assault and drug-related crimes.

[11] Note that unlike with the individual survey data of the YRBS, we do not have individual-level FBI data that allows us to conduct an analysis by both gender and race.

[12] Note that younger cohorts might also be affected because they may start investing in their human capital early on to avoid non-compliance later. Although the FBI provides data for crime committed by juveniles below 13 years of age, we restricted the sample to ages above 16 as all our regressions control for age-specific licenses which are only available for 16 years and above.

3.2 Youth Risk Behavior Survey

We discussed earlier how NPND laws might have a direct impact on crime through an increase in education. Nonetheless, it may also well be the case that a potential offender with a strong preference for driving returns to school to maintain driving privileges while conducting illegal activities in school. Because crime in school is likely to go unreported or sorted out without involving the police, we complement our FBI results with the Youth Risk Behavior Survey (YRBS). The YRBS is a national survey administered by the Centers for Disease Control and Prevention (CDC) every other year since 1991. The YRBS gathers information on risky behaviors of young adults in grades 9-12 such as tobacco and alcohol consumption, illegal drug use, and sexual and violent behavior. The objective of the survey is to identify the leading causes of morbidity and mortality among high schoolers within states.

State education and health agencies conduct an almost identical survey[13] to the YRBS that includes limited demographic characteristics useful for our analysis such as grade, age, gender and race. While not all states administer the state-level survey each year, since its first release in 1991, the proportion of states conducting the survey has steadily increased over our period of study.[14] We find a link between YRBS survey implementation and the passage of NPND laws unlikely. Nonetheless, to minimize this concern, we include state, year and time-varying economic (log of real per capita income, unemployment rate and poverty rate) and education controls (student teacher ratio, log of real teacher's salaries, log of real education expenditures).[15]

The CDC kindly provided us with the state-level surveys for the period 1991 to 2009. Table A1 in the Appendix shows all the states and years for which we were able to gather information. Despite its caveats, the YRBS has been widely used by economists to study range of policy-relevant issues involving sensitive youth behavior topics that are usually

[13]Some states add additional items in certain years while occasionally some states do not include a set of items asked in the national version of the questionnaire. For example, Utah does not include survey questions related to sex behavior.

[14]Table A.1. in the Appendix provides a list of states which provide publicly accessible data. For additional information about survey methodology of the YRBS see CDC, 2004.

[15]Table A.2. in the Appendix shows descriptive statistics for all control variables.

limited in other school survey data.[16]

Table 3 provides means and standard deviations for the main outcome variables used in the analysis of YRBS data by gender and race. We study five binary outcome variables that indicate the illegal activities in school; "Alcohol", "Marijuana" and "Weapons" are dummy variables that take the value of 1 if the respondent consumed alcohol, marijuana or carried a weapon, respectively, at least once in the last 30 days in school. "Fought in school" takes the value of 1 if the respondent had at least one fight in school in the past 12 months. "Felt unsafe in school" is equal to 1 if the respondent did not go to school at least once in the last 30 days because they felt unsafe at school.

Males are 17% likely to have had a fight in school in the past year and are three times more likely than females to miss school due to safety concerns. Both males and females are equally likely to indulge in underage drinking or consume marijuana in school. However, the threat of carrying a weapon to school is negligible for women and 12% for men.[17]

4 Empirical Strategy and Identification

To analyze the effect of NPND laws on education one could estimate a simple Differences-in-Differences model as follows:

$$\log(C_{ast}) = \beta_1 NPND_{st} + \beta_2 X_{st} + S + A + Y + \varepsilon_{ast}, \tag{1}$$

where the outcome C are arrests per 100,000 population by age group a, state s, and year t. $NPND_{st}$ is a dummy equal to one if the state s has a NPND in place in a particular year. S, A and Y are state, age, and year indicators, respectively. X_{st} are a range of time-variant state-specific characteristics that control for socioeconomic conditions which can affect crime rates.

[16]Some examples are Anderson (2014) who analyzes the effects of Compulsory Attendance Laws (CAL) on juvenile crime and Carpenter and Cook (2008) on the effect of cigarette taxes on youth smoking.

[17]We can also note that the overall incidence of alcohol and marijuana consumption seems high. This is however, consistent with the fact that teenagers tends to start experimenting with marijuana during their early teens and with descriptive statistics from other nationally representative datasets such as AddHealth. See Clark et al (2013).

The crucial identifying assumption is that different types of crime do not vary systematically in the treatment and control states over time in the absence of NPND laws. There could be potential sources of internal validity threats to this conventional identification assumption. First, if crime rates decrease due to other laws that are being enacted around the same time, our estimates would be biased. Second, there could be mean reversion if there was a downward trend in crime in treatment states at the time of the enactment of NPND laws but not in control states. Third, the intervention could be a response to another unobservable factor that simultaneously influences both the NPND laws implementation and crime. For instance, the sudden increase in teen traffic violations could lead to states passing NPND laws.[18]

A first simple visual inspection of the validity of the common-trends assumption is depicted in Figure 1. The red line indicates the crime rate on the first year that the NPND is in place and 0 is the last year in which there is no such a law enacted yet. We can see that average crime trend rates among 16-18 year old males does not seem to be already decreasing right before the law is being enacted for any particular crime.

To address threats to internal validity we employ an even more robust specification than (1), namely, a triple difference strategy. For this approach, we can rely explicitly on arrest data among older individuals as a more suitable control group to difference out unobserved state and year-specific crime shocks. This second specification exploits the variation in state and year data for 20 to 24 year olds. This control group consists of individuals who are unaffected by the NPND laws because NPND laws only affect those under 18 years of age.[19] Identification in this "differences-in-differences-in-differences" (DDD) framework relies on comparing the change in the gap between teen (16 to 18 year olds) and young adult (20 to 24 year olds) arrest rates in states that did and did not adopt NPND laws. Thus, consider

[18]NPND laws could also increase the incidence of individuals driving without a valid license. We have unsuccesully tried to gather data about traffic violations from the National Highway Traffic Safety Administration and state-level Departments of Motor Vehicles. Nonetheless using the Fatality Analysis Reporting System Data, we do not find any evidence that NPND laws increase traffic fatalities. Results available upon request to the authors.

[19]We do not include 19 year olds in the sample because they are in the margin of permissible age and may still be in school.

the following specification:

$$\log(C_{ast}) = \alpha_1 NPND_{st} + \alpha_2 T + \alpha_3 T * NPND_{st} + \alpha_4 X_{st} + S + Y + S * Y + R * Y + \epsilon_{ast}, \quad (2)$$

where T stands for treated cohort and it is a binary variable that takes the value of 1 if the age group comprises of 16 to 18 year olds and 0 if it comprises 20 to 24 year olds. In this specification, we are interested in α_3, the coefficient on the interaction between NPND laws and being in a treated cohort (T). X_{st} includes macroeconomic controls, traffic-related control variables and education specific controls. The macroeconomic variables include log of real per capita income, log of male population, unemployment rate, poverty rate and percentage of black population. In addition we also control for log of size of the police force. Education related controls include the student teacher ratio, log of real teacher's salaries, log of real education expenditures and minimum dropout ages.[20] In the regressions where DUI arrests is the outcome variable, we also control for several traffic-related variables, namely, log of age-specific total number of driving licenses, log of vehicle miles travelled, whether there is a graduating licenses law in place, and dummy variables for primary and secondary seat belt laws.[21] All income and expenditure variables are inflation-adjusted and errors are clustered at the state level (Duflo and Mullainathan 2004). We include a vector of linear state-specific time trends in all the FBI regressions.

Stephens and Yang (2014) argue that several past studies using variation in U.S. state schooling laws to look at the effect of increased schooling fail to satisfy the identification assumption. This is because differential changes across states, such as relative school quality improvements, would result in the failure of the common trend assumption. Following their paper, we allow year effects to vary across regions. This is captured in the above equation by including region (R) times year effects (Y).[22]

[20] All state level education data has been obtained from the National Center for Education Statistics (NCES).

[21] The age-specific license variable is included in all regressions (and not just DUI) in order to capture the extent of exposure to a car which may directly affect crime rates.

[22] Estimates do not change when using a more parsimonious specification without region interactions. Results available upon request to the authors.

5 Results

5.1 Effects of NPND on Reported Crime

Table 4 shows the results from the DDD specification where the outcome variable is different types of crimes committed. The main variable of interest is the interaction between NPND laws and the binary variable that equals to 1 if the age group is 16 to 18 and zero for the ages 20 to 24. Consistent with the predictions, the first column in Table 4 shows that due to NPND laws, 16-18 year old males are significantly less likely relatively to 20-24 year olds to be arrested for rape, larceny, motor vehicle thefts, arson and illicit drug possession or sale in states where an NPND is being passed. At the same time, they are more likely to be arrested for drunkenness. Among females (column 3), we find a decrease in arrests due to robbery, motor vehicle thefts and drug sales/manufacture with of approximately 0.37, 0.47 and 0.24 percent respectively relative to older cohorts, respectively. As with the case of males, there is an increase in the probability of arrests due to drunkenness.

Examining a large number of outcomes for various subpopulations can derive multiple inference problems and the over-rejection of the null-hypothesis (Type I error) increases as additional outcomes are analyzed, even in the absence of a true effect.[23] Thus, in Table 5 we present results for all types of crimes added together, violent crimes (murder, rape, robbery, simple and aggravated assaults), property crimes (larceny, burglary, motor vehicle theft, and arson), drug-related crimes (selling, manufacturing and possession) and DUI.

We can see in Column (1) that having an NPND in place has significant negative effects on arrests among males. Among the affected cohort of male teenagers, there is an approximate 0.24 percentage percentage reduction in all arrests relative to 20 to 24 year olds. In particular, there is an approximately 0.19 percentage decrease in arrests due to property and violent crimes, respectively. There is no effect of NPND on DUI arrests. If we compare males with females in Column (4), there is, however, a very large and statistically significant negative effect on drug-related crimes among both genders (coefficient of 0.29 for males and 0.32 for females).[24]

[23] See Romano and Wolf (2005) for a theoretical analysis of the issue.

[24] In results not shown here, we find no effect on white collar crime in the DDD specification for either males or females.

At this point, it is worth comparing these estimates to those found in the literature. Anderson (2014) finds that a minimum dropout age of 18 decreases arrest rates for all types of crime, property crime and violent crime among 16 to 18 year olds by approximately 10 to 23%. The estimated effects are usually not statistically significant for drug-related arrests though the magnitudes are very large. Our estimates from the DDD specification are comparable at 24% for all types of crime, 18.5 percent for property crime and 19.6 percent for violent crime among males. However, we find that NPND laws are associated with a large negative effect on drug crime amounting to a 29% and 32% reduction in male and female arrests, respectively and that we are comparing 16-18 year olds versus older cohorts.[25]

While these magnitudes are quite large, we should note that there are several channels by which NPND can impact crime rates. First, the law affects students at the margin of dropping out beyond compulsory attendance age. Thus, it is not forcing teenagers to stay in school longer but encourages them to do so if they have a preference for driving. Thus, these teenagers are positively selected among those only affected by compulsory attendance laws.

Second, most NPND states impose minimum attendance requirements, academic and good behavior standards, in addition to school enrollment which motivates additional human capital accumulation, a variation that we exploit further in the following section. Consistently, Barua and Vidal-Fernandez (2014) find that students who remained in school increased time allocated to school-work at the expense of leisure and work hours.

Finally, NPND laws differ from CAL's in the age at which teenagers are affected. It is clear from Table 1 that NPND laws constrains students, who care for driving, to stay in school even beyond the minimum compulsory attendance age. There should be a higher payoff from graduating from school than from attending beyond the minimum compulsory attendance age and those who are aware are reacting to that. In addition, those who stay in school to retain driving privileges are getting a year or two of additional schooling than those dropping out after CAL which will have an additional negative effect on crime.

This is confirmed by looking at the remaining columns of Table 5. In columns (2), (3),

[25]Anderson (2014) finds however, comparable estimates for drug related arrests among males (i.e. of the order of 28%). However the effects are statistically insignificant.

(5) and (6), we divide the sample by gender and states with a CAL of 18 and those with CAL of less than 18. We find that none of the coefficients are statistically significant for the states with a minimum dropout age of 18. On the other hand, in states where the dropout age is less than 18, NPND laws should increase the likelihood that teenagers with a preference for driving remain in school for longer. Consistently, in columns (3) and (6), we see that the crime-reducing effect of NPND laws is large and highly significant. These results are consistent with our hypothesis that NPND laws have large externality effects on crime and can be complementary to compulsory attendance laws.

5.2 Behavior versus Academic Progress

NPND laws do not only condition drivers license on enrollment, but also 11 NPND states impose additional requirements on behavior and satisfactory academic progress in school. The heterogeneity in the strictness of the law gives us an additional source of variation in the data. Moreover, it allows us to study the effect of conditioning licenses on academic performance versus conduct.

For example, the statute for Tennessee, which also conditions license on academic progress, states:

"*A student who fails to maintain satisfactory academic progress based on end of semester grading may not be considered as being in compliance with this section until such student makes a passing grade in at least three (3) full unit subjects or their equivalency at the conclusion of any subsequent grading period.*"

Similarly, Louisiana which also imposes behavioral restrictions suspends license for any student who has been expelled or suspended from school for ten or more consecutive days due to

"*...infractions involving the sale or possession of drugs, alcohol, or any other illegal substance, the possession of a firearm, or an infraction involving assault or battery on a member of the school faculty or staff.*"

A stricter law that also conditions on academic progress should theoretically lead to an increase in time spent on academic activities. On the other hand, a law that imposes behavioral conditions may lead to a rotten-apple effect as it forces students with the worst

behavioral problems, but those who care for driving, to stay in school.

To test for the differences across these two types of states, we can use an identification strategy which relies only on variation within NPND states in the strictness of the law. In this specification, the first difference arises from comparing states that passed NPND at different points of time. The second difference is between 16-18 year olds and 20-24 year olds in NPND states. The third difference arises from comparing states that have stricter NPND rules (that condition on academic progress or behavioral requirements) relative to other NPND states.

Thus, we estimate the following DDD specification:

$$\log(C_{ast}) = \alpha_1 Stricter_{st} + \alpha_2 T + \alpha_3 T * Stricter\ law_{st} + \alpha_4 X_{st} + S + Y + S*Y + R*Y + \epsilon_{ast}, \quad (3)$$

where *Stricter* takes the value of 1 if it is a NPND state that conditions on academic progress (or Behavior) and 0 for all other NPND states.[26] All other variables are the same as in the baseline specification. In this model, we compare crime outcomes for 16 to 18 year olds with 20 to 24 year olds within states with NPND laws but those that differ by strictness of the law. We also focus on the group with the largest negative effect on crime in Table 5 i.e. males in states where the compulsory attendance law is less than 18.

Column (1) in Table 6 shows that NPND states that also condition on behavior are neither better off nor worse off than remaining NPND states in crime outcomes among males. This could be because, while on the one hand, NPND leads to a reduction in crime, but on the other hand, there is an increase in crime within schools as the students with the most behavioral problems are forced to stay in school. Interestingly, in states where academic progress is an additional requirements (column 2), there are large negative effects on arrests compared to remaining NPND states. This suggests again that there seem to be large externality effects of education.

To test directly if these results imply that there is an increase in in-school crime in states that condition on behavior, we next study outcomes in the YRBS data in Table 7. The

[26]Tennessee is the only state with both academic and behavior requirement. Results are robust to the classification or exclusion of this state in the analysis.

negative effect of NPND laws on reported crime could be at the expense of an increase in in-school offenses if potential criminals are not deterred nor incapacitated when staying in school to apply or retain their driving licenses. Thus, we study next the effect of NPND laws on crime and substance abuse within schools using the YRBS data that surveys relevant information of affected cohorts in school.

Because the YRBS surveys only high school students, we show difference-in-differences results for five variables that indicate presence of illegal or aggressive activities within school premises: having consumed alcohol, marijuana, carrying a weapon to school, being involved in a fight in school in the last 30 days, and felt threatened or unsafe in the last year. To make the results comparable to the FBI findings, we show results among males separately by strictness of the NPND laws. All regressions include state and year fixed effects, region times state fixed effects, the full set of state and year-specific macroeconomic and education controls used previously in the FBI analysis. In addition, we control for age and age-squared and race.[27]

The first panel of Table 7 shows differences-in-differences estimates for NPND versus non-NPND states.[28] We find no evidence that NPND laws led to an increase in in-school offenses. Though the coefficients are insignificant for males, we find that all groups together and females are less likely to miss school due to safety concerns.[29] This finding is consistent with Barua and Vidal-Fernandez (2014) who show that NPND laws increase the time spent doing homework at the expense of leisure activities and that the effect is also evident within females, most likely due to peer effects.

It is important to note that these results could be driven by an increase in human capital accumulation or a deterrence effect of being in school but also due to an incapacitation effect. This is because criminal opportunities available in school are likely to be different from those available outside of school even if NPND laws do not change the opportunity cost of risky behaviors. For example, if a significant proportion of youth criminal activity

[27]Note also that state-specific trends are not appropiate in these specifications given that, as reported in Table A.1 in the Appendix, states do not conduct YRBS in consecutive years. Finally, a triple difference specification is not possible as all respondents are in high school and thus, belong to affected cohorts.

[28]Given the high variance in response rate between states discussed in Section 3.2, we have used all the avaialable information in in the YRBS. Results using a balanced sample yield similar but more imprecise estimates. Results available upon request.

[29]Results not shown here, but available upon request

involves vandalism, and teenagers are monitored in school, then the effect of NPND laws on crime could operate partially through an incapacitation effect. To distinguish between these channels, Table 7 also reports difference-in-differences estimates by strictness of the law. Panel B shows results for coefficient on a dummy variable =1 for states with behavior as an additional requirement (and zero for all remaining NPND states) while Panel C shows results for academic performance. Note that non-NPND states are excluded from the sample.

Since we are focussing on in-school crime, any effect on crime is either due to a human capital effect or a "rotten apple" effect. While human capital would theoretically decrease in-school crime, the rotten apple effect may increase crime in school. Results from Panel B show that in states which condition NPND laws on behavior, students are 24% more likely to consume drugs and 29% more likely to have fights in school. This is consistent with a rotten-apple effect as it forces students with the worst behavioral problems, but those who care for driving, to stay in school. On the other hand, the DD specification in Panel C yields negative and significant effects for four out of the five outcomes. Relative to other NPND states, in those states where academic progress is a precondition for a driving license, males are significantly less likely to carry weapons, consume marijuana or fight in school. At the same time, they are less likely to skip school due to safety concerns. This is consistent with a human capital externality effect.

In sum, we find that a negative incentive that conditions drivers licenses among teenagers on academic progress leads to lower crime both within school and overall. On the other hand, states that impose behavioral restrictions on students leads to higher in-school crime and no effect on overall crime rates.

6 Discussion

We study the effect of NPND laws, a policy encouraging teenagers with a preference for driving to stay in school beyond the minimum dropout age, on an important education externality, namely, crime. Using a difference-in-difference-in-difference-type empirical strategy and data from the Federal Bureau of Investigation (FBI), we find that NPND laws led to a significant decline in arrests due to violent, property and drug crimes among males. We

find a decline of 24% for all types of crime, 18.5 percent for property crime and 19.6 percent for violent crime among males. Moreover, NPND laws are associated with a large negative effect on drug crime amounting to a 29% and 32% reduction in male and female arrests, respectively.

Further, analyzing data from a school level survey that gathers information on risky behaviors of young adults in grades 9-12, we find some evidence that potentially criminal activities are also decreased in school among states that condition driving license on academic progress. On the other hand, states that impose behavioral restrictions on students leads to higher in-school crime and no effect on overall crime rates. These results are important for education policy as they suggest that negative incentives that condition on academic progress have significant positive externality effects. At the same time, states that impose behavioral restrictions on teenagers have to be cautious as it generates "rotten-apple" effects and may in fact lead to an increase in in-school crime.

We argue that NPND laws, when conditioning on academic performance, are a relatively low cost policy that increases education and generates positive externalities beyond and in addition to the minimum drop out age laws. Finally, this results sheds light on the possibility that policies targeted at increasing education within disadvantaged teenagers might not only decrease crime but also be very cost-effective (Fryer 2016).

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Tables and Figures

Table 1: Summary of No Pass No Drive Laws

State	Year	Attendance	School Progress	Student Behaviour	Minimum Age	Maximum Age	Dropout Age
Alabama	1993	Yes			13	19	16
Arkansas	1991	Yes			14	18	18
California	1991	Yes			13	18	16
Delaware	2000	Yes			-	-	18
Florida	1997	Yes			15	18	
Georgia	1998	Yes			15	18	16
Idaho	1996	Yes			15	18	16
Illinois	2005	Yes		Yes	-	18	16
Indiana	1991	Yes		Yes	15	18	18
Iowa	1994	Yes			-	18	16
Kansas	1999			Yes	13	-	17
Kentucky	1990		Yes		16	18	17
Louisiana	2004			Yes	15	18	16
Mississippi	1994*		Yes		15	18	16
Nevada	2003	Yes			14	-	16
New Mexico	2004	Yes			-	-	16
North Carolina	1997		Yes		15	18	18
Ohio	1992*	Yes			-	18	18
Oklahoma	1996	Yes			14	18	17
Oregon	1995			Yes	15	21	16
South Carolina	1998	Yes			15	17	17
Tennessee	1990	Yes	Yes	Yes	15	18	18
Texas	1995	Yes			15	18	16
Virginia	1993*	Yes			16	18	16
West Virginia	1988		Yes		15	18	16
Wisconsin	1988*	Yes			16	18	

*First year in which state statutes include reference to a NPND law.

Table 2: Average yearly arrests of 16-18 year olds, 1998-2010

	16-18 Males	20-24 Males	16-18 Females	20-24 Females
All crime	9.7	26,850	2.5	6,127
	(11.8)	(14,644)	(2.7)	(3,341)
Violent crime				
Murder	0.02	44.1	0.00	4.04
	(0.03)	(23)	(0.01)	(2.09)
Manslaughter	0.00	3.7	0.00	0.66
	(0.00)	(1.9)	(0.00)	(0.33)
Robbery	0.16	287	0.01	27.5
	(0.32)	(155)	(0.03)	(14.7)
Sex Crimes/rape	0.04	124	0.00	15.8
	(0.07)	(62)	(0.01)	(6.8)
Assault	0.23	821	0.05	171
	(0.38)	(379)	(0.07)	(82)
Property crime				
Larceny	0.88	1,248	0.47	721
	(0.92)	(692)	(0.52)	(400)
Burglary	0.37	560	0.03	81.6
	(0.55)	(286)	(0.09)	(34)
Motor vehicle theft	0.20	280	0.03	41.5
	(0.38)	(126.8)	(0.05)	(17.8)
Arson	0.01	15	0.00	2.56
	(0.01)	(9)	(0.00)	(1.5)
Drug-related crime				
Drugs Sale/Manufacture	0.98	2,960	0.14	528
	(1.4)	(1,582)	(0.21)	(267)
Drug Possession	0.73	2,099	0.12	403
	(1.1)	(1,120)	(0.18)	(200)
Other crime				
Drunkenness	0.18	886	0.03	108
	(0.56)	(519)	(0.07)	(68)
Driving Under the Influence (DUI)	0.22	2,560	0.04	474
	(0.38)	(1,254)	(0.07)	(245)
Illegal possession of weapons	0.19	426	0.01	27
	(0.31)	(219)	(0.01)	(15)

Notes: Arrests per 1,000 inhabitants. Standard deviations in parentheses.

Table 3: Descriptive Statistics of Outcome Variables in YRBS

	Males	Females	Blacks	Whites	All
Fought in school	0.17	0.08	0.17	0.11	0.13
	(0.38)	(0.27)	(0.37)	(0.31)	(0.33)
Felt unsafe in school	0.12	0.04	0.08	0.07	0.08
	(0.32)	(0.19)	(0.27)	(0.26)	(0.27)
Weapon in school	0.12	0.02	0.08	0.07	0.07
	(0.33)	(0.14)	(0.27)	(0.25)	(0.26)
Consumed alcohol in school	0.40	0.38	0.33	0.41	0.39
	(0.49)	(0.48)	(0.47)	(0.49)	(0.48)
Smoked marijuana in school	0.35	0.29	0.35	0.31	0.32
	(0.48)	(0.45)	(0.47)	(0.46)	(0.46)

Notes: Standard deviations in parentheses. Fought=1 if the respondent had at least one fight in the last 12 months. Felt unsafe in school, weapons, alcohol and marijuana are equal to 1 if, within the last 30 days, the respondent did not go to school at least once because they felt unsafe in school, carried a weapon to school or consumed alcohol or marijunana in school premises.

Figure 1: Crime Rates of 16-18 year olds vs. 20-24 year olds in NPND states

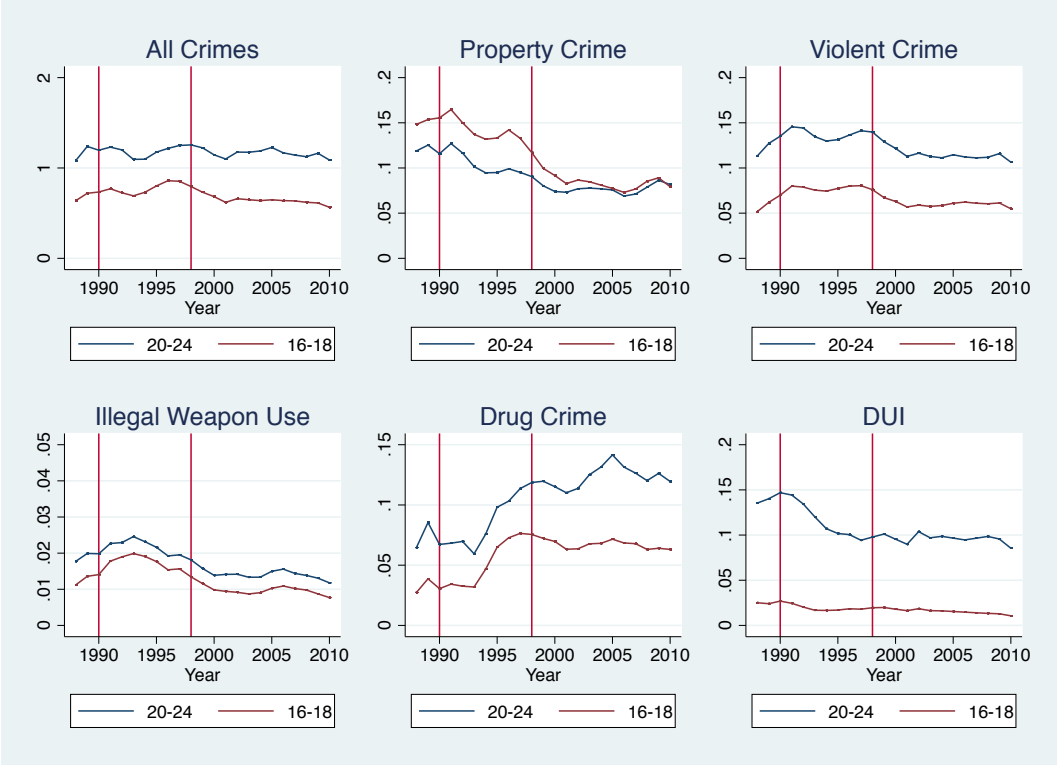


Table 4: Effect of NPND on Crime by Gender: DDD Specification

	(1)	(2)	(3)	(4)
	Males	N	Females	N
Murder	-0.072	2,772	-0.003	1,817
	(0.128)		(0.128)	
Manslaughter	-0.149	1,722	-0.132	1,132
	(0.146)		(0.226)	
Robbery	-0.204	3,156	-0.371***	2,847
	(0.164)		(0.129)	
Sex crimes/rape	-0.391***	3174	-0.096	2,408
	(0.143)		(0.174)	
Assault	-0.157	3,201	-0.064	3,148
	(0.113)		(0.143)	
Larceny	-0.194*	3,204	-0.074	3,203
	(0.105)		(0.096)	
Burglary	-0.009	3,204	-0.090	3,171
	(0.097)		(0.139)	
Motor vehicle theft	-0.439***	3199	-0.470***	3,136
	(0.121)		(0.153)	
Arson	-0.248**	3,050	-0.165	2,227
	(0.111)		(0.133)	
Drug sale/manufacture	-0.231**	3204	-0.242**	3,200
	(0.104)		(0.116)	
Drug possession	-0.237**	3,149	-0.287**	3,140
	(0.116)		(0.131)	
Drunkenness	1.443***	2,352	0.858**	2,185
	(0.412)		(0.362)	
Driving Under the Influence (DIU)	-0.244	3,140	-0.264	3,140
	(0.146)		(0.178)	
Possession or carrying of weapons	-0.130	3,185	-0.245*	2,919
	(0.137)		(0.142)	

Notes: Standard errors clustered at the state level in parentheses. Outcome variable in logs. *** p<0.01, ** p<0.05, * p<0.1. Coefficients on NPND*treatment group (age 16 to 18). Control group consists of individuals between 20 to 24 years of age. All regressions include state, year, region*state fixed effects and state-specific linear time trends. Regressions include the full set of state, year specific macroeconomic, traffic (only for DUI regression) and education variables, log of age-specific population and log of age-specific driving licenses.

Table 5: Effect of NPND on Arrests By Gender and Drop Out Ages, DDD Specification

	Males			Females		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	CAL 18	CAL<18	All	CAL 18	CAL<18
All crime						
NPND*Age16to18	-0.241**	-0.137	-0.270***	-0.201*	-0.133	-0.205*
	(0.090)	(0.161)	(0.096)	(0.112)	(0.164)	(0.115)
N	3,204	823	2,381	3,204	823	2,382
Property crime						
NPND*Age16to18	-0.185*	0.014	-0.243**	-0.088	0.057	-0.126
	(0.092)	(0.187)	(0.100)	(0.093)	(0.185)	(0.091)
N	3,204	823	2,381	3,204	823	2,381
Violent crime						
NPND*Age16to18	-0.196*	0.046	-0.272**	-0.154	0.065	-0.200*
	(0.099)	(0.210)	(0.101)	(0.111)	(0.230)	(0.109)
N	3,204	823	2,381	3,204	823	2,381
Drug-related crime						
NPND*Age16to18	-0.289**	-0.166	-0.312**	-0.325**	-0.280	-0.292*
	(0.117)	(0.223)	(0.138)	(0.127)	(0.198)	(0.147)
N	3,151	815	2,336	3,151	815	2,336
DUI						
NPND*Age16to18	-0.244	-0.392	-0.239	-0.264	-0.276	-0.242
	(0.146)	(0.417)	(0.152)	(0.178)	(0.354)	(0.198)
N	3,140	798	2,342	3,140	789	2,342

Notes: Standard errors clustered at the state level. Outcome variable in logs. *** p<0.01, ** p<0.05, * p<0.1. Coefficients on NPND*treatment group (age 16 to 18). Control group consists of individuals between 20 to 24 years of age. All regressions include state, year, region*state fixed effects and state-specific linear time trends. Regressions include the full set of state, year specific macroeconomic, traffic (only for DUI regression) and education variables, log of age-specific population and log of age-specific driving licenses. Violent crime includes manslaughter, murder, robbery, rape, assaults; property crime includes larceny, burglary, motor vehicle theft, arson; drug crimes include possession, sale/manufacture of drugs. CAL stands for School Compulsory Attendance Law. DUI stands for Driving Under the Influence.

Table 6: Effect of NPND Strictness on Crime in States with CAL<18 years, DDD

	Behaviour	**Academic Progress**
	(1)	(2)
All crime		
Strict law*Age16to18	-0.020	-0.660***
	(0.178)	(0.195)
N	1,007	1,007
Property crime		
Strict law*Age16to18	-0.001	-0.628***
	(0.235)	(0.220)
N	1,007	1,007
Violent crime		
Strict law*Age16to18	0.041	-0.576**
	(0.174)	(0.248)
N	1,007	1,007
Drug-related crime		
Strict law*Age16to18	-0.385	-0.416**
	(0.422)	(0.153)
N	1,001	1,001
Driving under the Influence (DUI)		
Strict law*Age16to18	-0.416	-0.444*
	(0.396)	(0.221)
N	1,004	1,007

Notes: Standard errors clustered at the state level in parentheses. Outcome variable in logs. *** p<0.01, ** p<0.05, * p<0.1. Column (1) shows results for the interaction of NPND states with behavioral requirements and 16 to 18 year olds. Column (2) shows results for the interaction of NPND states with academic requirements and 16 to 18 year olds. Control group consists of 20-24 year olds in NPND states.

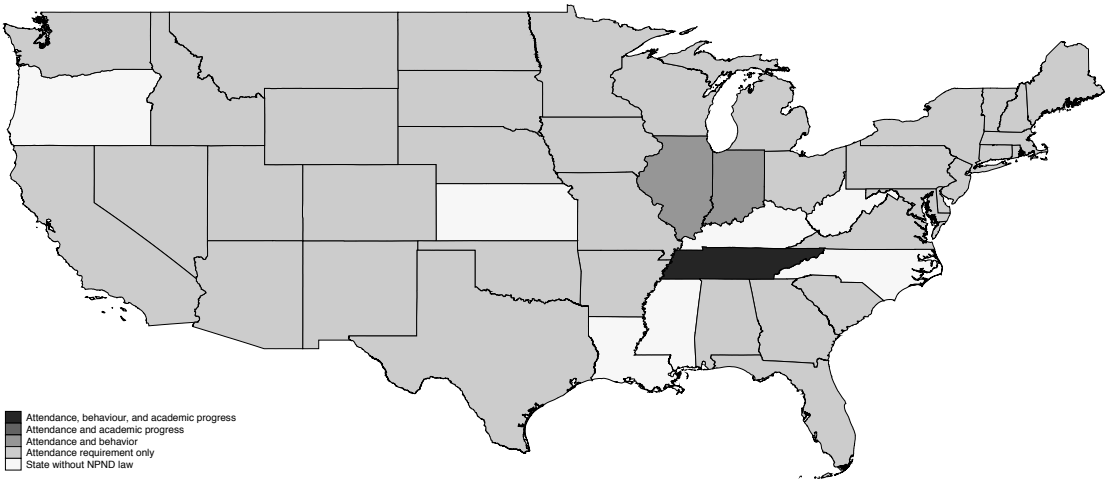
Table 7: Effect of Law Strictness of NPND on Male's Risky Behavior, YRBS

	Weapons	Felt unsafe	Fought	Alcohol	Marijuana
	(1)	(2)	(3)	(4)	(5)
Panel A: NPND vs non-NPND					
NPND	0.003	-0.012	0.010	-0.001	0.015
	(0.007)	(0.009)	(0.006)	(0.014)	(0.014)
N	200,499	256,716	259,337	260,978	230,997
Panel B: Behavior vs Other					
Behavior	-0.090	0.290	0.294**	0.049	0.243***
	(0.066)	(0.199)	(0.129)	(0.038)	(0.035)
N	71,921	86,917	87,095	82,794	82,281
Panel C: Academic Progress vs Other					
Academic Progress	-0.084***	-0.141***	-0.091**	-0.009	-0.508***
	(0.012)	(0.043)	(0.033)	(0.039)	(0.128)
N	71,921	86,917	87,095	82,794	82,281

Notes: Standard errors clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1. Column (1) shows results for coefficient on a dummy variable =1 for states with behavior as an additional requirement (and zero for all remaning NPND states) while Column (2) shows results for academic performance. All regressions include state, year, region*state fixed effects, macroeconomic, traffic and education controls, age, and age squared. All include dummies for race (Black, White, and Hispanic) and a dummy for male. par

Appendix

Figure 2: States with NPND Laws



Notes: Alaska and Hawaii do not have NPND Laws in place

Table A.1: YRBS Available Data

State	2007	2005	2003	2001	1999	1997	1995	1993	1991
Alabama	0	1	1	1	1	1	1	1	1
Alaska	1	0	1	0	0	0	1	0	0
Arkansas	1	1	0	1	1	1	1	0	0
Connecticut	1	1	0	0	0	1	0	0	0
Delaware	1	1	1	1	1	0	0	0	0
Iowa	1	1	0	0	0	1	0	0	0
Idaho	1	1	1	1	0	0	0	1	1
Illinois	1	0	0	0	0	0	1	1	0
Kansas	1	1	0	0	0	0	0	0	0
Kentucky	0	1	1	0	0	0	0	0	0
Lousiana	1	0	0	0	0	0	0	0	0
Maryland	1	1	0	0	0	0	0	0	0
Maine	1	1	1	1	0	1	1	0	0
Missouri	1	1	1	1	1	1	1	0	0
Mississippi	1	0	1	1	1	1	1	1	0
Montana	1	1	0	1	1	1	1	0	0
North Carolina	1	1	1	1	0	0	1	1	0
North Dakota	1	1	1	1	1	0	1	0	0
Nebraska	0	1	1	0	0	0	0	1	1
New Jersey	1	1	0	1	0	0	0	0	0
NY	1	1	1	0	1	1	0	0	0
Oklahoma	1	1	1	0	0	0	0	0	0
Rhode Island	1	1	1	1	0	1	0	0	0
South Carolina	1	1	0	0	1	1	1	1	1
South Dakota	1	1	1	1	1	1	1	0	1
Tennessee	1	1	0	0	0	0	0	1	0
Utah	1	1	1	1	1	1	1	1	1
Wisconsin	1	1	1	1	1	1	0	1	0
West Virginia	1	1	1	0	1	1	0	1	0
Wyoming	1	1	0	1	1	0	1	0	0

Notes: Arizona, Colorado, Florida, Georgia, Hawaii, Indiana, Massachusetts, Michigan, Nevada, New Hampshire, New Mexico, Ohio, Texas and Vermont did not provide the CDC permission to share their data.

Table A.2: Juvenile vs. Non-Juvenile Crime

	Juvenile	**Non-Juvenile**
Murder	0.62	2.6
	(0.07)	(0.2)
Manslaughter	0.05	0.44
	(0.01)	(0.05)
Rape	0.68	4.7
	(0.07)	(0.33)
Robbery	9.7	15
	(0.95)	(1.4)
Agravated assault	13.8	71.6
	(1.04)	(6.5)
Forgery	1.6	20.1
	(0.11)	(1.8)
Embezzelment	0.38	3.6
	(0.05)	(0.32)
Possession or carrying of weapons	10.1	24.1
	(0.81)	(1.9)
Drug-related crimes	24	131
	(2)	(11.4)
Drunkenness	2.3	52
	(0.3)	(4.7)
Driving under the influence	2.8	240
	(2.4)	(17)

Notes: Arrests per 100,000 inhabitants. Average of U.S. population under 18 is 24% (US Census, 2010).

Table A.3: Descriptive Statistics of Control Variables

Variable	Mean	Standard deviation
Unemployment	5.59	2.32
Log (per capita income)	10.21	0.34
Percentage black	12.09	7.77
Poverty rate	12.49	3.66
Police size	9.13	1.05
Log (Male population)	11.72	3.42
Log (Female population)	11.67	3.41
Log (Licenses)	11.01	1.40
Log (Vehicle miles)	10.36	1.01
Graduate driving license law	0.43	0.49
Primary seatbelt law	0.61	0.49
Secondary seatbelt law	0.32	0.46
Pupil to teacher ratio	16	2.45
Log (Teacher salaries)	10.56	0.23
Log (Expenditure per pupil)	8.91	0.38
Drop out age	16.74	0.89

Sources: Education variables: National Center for Education Statistics (NCES). Employment, income and population variables: Bureau of Labor Statistics. Traffic-related variables: National Highway Traffic Safet Administration (NHTSA). Size of police force: FBI. Information of laws have been gathered by the authors.