Date of Birth, School Indiscipline and Crime

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May 2019

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Abstract

A sizeable literature documents that early school eligible (ESE) juveniles suffer academic disadvantage and face a greater risk of committing youth crime. Very little is known about the educational experience of these juveniles and the way this translates into future criminal participation. Using administrative data matching education and criminal records from Queensland, this paper studies the educational experience and criminal participation of ESE juveniles. When ESE juveniles are forced to stay on at school, schools discipline them more as they internalise their bad behaviour. However, school disciplinary sanctions seem beneficial as they reduce the future criminal activity of serial offenders.

JEL Keywords: Youth crime; date of birth; school attendance.
JEL Classifications: I2; K42.

Acknowledgements

We would like to thank Peter Conroy and Sandra Smith from the Queensland Police Service, and Angela Ferguson and Mark McDonell from the Queensland Education Department (QED) for their help in negotiating access to their respective administrative data sets and enabling individual level data merging. We would also like to thank Abhijit Banerjee, Anna Bindler, Sandra Black, Rui Costa, Emilia Del Bono, Richard Disney, Pascaline Dupas, Tom Kirchmaier, Stephen Machin, Sandra McNally, Imran Rasul, Jenifer Ruiz-Valenzuela, Ben Vollard, Felix Weinhardt and other seminar participants at the London School of Economics, NIESR, the University of Queensland, Griffith University, the University of Glasgow, Jinan University, the 2018 International Workshop of Applied Economics of Education, the 2018 European Society of Population Economics, the 2018 CEP (LSE) Glasgow Workshop on the Economics of Crime and Policing, the 2018 Asian and Australasian Society of Labour Economics and the 2019 Royal Economic Society Conference for their feedback on our early results.

1. Introduction

Juvenile crime is a significant policy issue. As crime rates increase steadily until around age 18–20 and then decrease later in life (Quetelet, 1831; and Landersø, Nielsen and Simonsen, 2016), the educational experience can play a critical role in determining participation in criminal activity over the lifetime of an individual.[1] The link between crime and school attendance has been documented for most crime types and in a variety of settings, including the US (Jacob and Lefgren, 2003; Lochner and Moretti, 2004; Luallen, 2006; Anderson, 2014; Bell, Costa and Machin, 2016; Bell, Costa and Machin, 2018), England and Wales (Machin, Marie and Vujic, 2011), Sweden (Hjalmarsson, Holmlund and Lindquist, 2015) and, more recently, Australia (Beatton, Kidd, Machin and Sarkar, 2017). This literature employs a variety of sources of exogenous variation in school attendance including idiosyncratic school closure dates for teacher training (Jacob and Lefgren, 2003) or teacher strikes (Luallen, 2006), as well as changes in the minimum school leaving age (Lochner and Moretti, 2004; and Machin et al., 2011). The consensus is a beneficial crime-reducing effect of school attendance.

Recent literature suggests that starting school at a younger age may place juveniles at a greater risk of committing crime (Cook and Kang, 2016; Depew and Eren, 2016; and Landersø et al., 2016). This is consistent with the finding that starting school at a younger age leads to a significant academic disadvantage from childhood (Bedard and Dhuey, 2006; Datar, 2006; Puhani and Weber, 2007; McEwan and Shapiro, 2008; Elder and Lubotsky, 2009; Crawford, Dearden, and Meghir, 2010; Black, Devereux, and Salvanes, 2011; and McCrary and Royer, 2011). Cunha and Heckman (2008) suggest that starting school at an earlier age may have significant lifetime effects, as it has the potential to alter the entire path of skill acquisition.

What is currently much less well understood is how early school eligibility and the school-starting age affect the educational experience of juveniles and, in turn, how the initial disadvantage

[1] The terms juvenile, youth and adolescent are used interchangeably throughout the paper.

in school performance leads to greater future criminal participation. In the United States (US), 1.4 million school crimes were recorded in public schools in the 2015/16 school year, with only 449,000 crimes, i.e. less than one in three, reported to the police (US Department of Education).[2] In England, more than 30,000 school crime offences were recorded in 2015.[3] In 2019, the potential responsibility of the education system in the recent nationwide spate of fatal juvenile stabbings has received significant press coverage.[4] In Australia, from July 2015 to June 2016 the police proceeded against 55,000 young offenders (Australian Bureau of Statistics, 2017). While the main rationale behind compulsory schooling laws is to lift the human capital and labour market prospects of potential dropouts, the primary experience of compulsory education for low-performing individuals is one of being forced to attend school with a particular group of better-performing students.[5] If juveniles are incapacitated at school against their will, the compulsory schooling period may turn out to be actively formative for their crime capital accumulation. On the other hand, the adoption of behavioural rules and the use of discipline sanctions in school may contribute to the education production function (Lazear, 2001) and thus alter the criminal participation of a juvenile. Generating an understanding of this experience and how it affects the future criminal behaviour is a first order research question in the economics of crime.

This paper studies the impact of early school eligibility on the educational experience and criminal participation of juveniles in the institutional context of the state of Queensland in Australia. Focusing on children born around the 1st January, it presents a regression discontinuity design (RDD) analysis of the impact of early school eligibility on crime and school suspensions. Administrative rules governing school entry eligibility in Queensland state that a child is expected to start school in the school year in which s/he turns six. Thus children born around the 1st January are subject to a discontinuity in school entry eligibility that can be exploited. Using matched administrative data on

[2] See https://nces.ed.gov/fastfacts/display.asp?id=49.
[3] See https://www.bbc.co.uk/news/education-34268942.
[4] See https://www.bbc.co.uk/news/education-47537631.
[5] A growing literature has started to document the negative effects of exposure to higher-performing peers in school (Murphy and Weinhardt, 2018).

education and crime for the state of Queensland, the analysis compares the propensity to commit crime and receive school suspensions of juveniles born 60 days either side of the 1st January cut-off. Availability of information on the actual secondary school starting age enables us to instrument the actual young in cohort (YINC) status with an indicator of whether a juvenile is early school eligible (ESE) (i.e., whether s/he was born within 60 days before the 1st January cut-off). This takes into account the potential for parental over-riding of administrative rules.

The empirical findings show that ESE juveniles aged 15 to 24 are more likely to commit criminal offences as well as to receive School Disciplinary Absences (SDAs), i.e. school suspensions, in secondary school.[6] These conclusions are robust to equation specification and bandwidth selection, as results appear entirely consistent when either 90-day, 60-day or 30-day bandwidths either side of the 1st January cut-off are adopted. The estimated effects also appear robust to potential parental over-riding of administrative rules, as the IV estimates lead to the same conclusion that the YINC juveniles are more likely to commit crime and be suspended from school. Finally, results are also robust across parametric and non-parametric local linear regression estimation.

When the impact of ESE status on crime and school suspensions is estimated separately by age, ESE juveniles appear to receive more school suspensions for each age from 15 to 17, but do not commit more crime. However, once they turn 18, ESE juveniles commit more criminal offences up until age 24. As the minimum school leaving age in Queensland is 17, juveniles aged 18 or older are no longer subject to compulsory school attendance.[7] Thus, this crime-age profile is consistent with an incapacitation effect of school on crime, but also with the notion that compulsory school attendance shifts the bad behaviour of ESE juveniles from outside to inside school. The same conclusion emerges for both the reduced-form OLS effect of ESE status and the structural IV effect of YINC status on crime and school suspensions.

[6] SDAs in Australia are equivalent to suspensions in the US and to temporary exclusions in the UK.
[7] The minimum school leaving age was raised from 16 to 17 in 2006 in Queensland. Further details of this reform are provided in Section 3.

Individual-specific estimates reveal a close correspondence between the identity of juveniles who receive school suspensions and the identity of those who commit criminal offences. Average percentile youth-specific effects of ESE status on crime are plotted against percentile youth-specific effects of ESE status on school suspensions. This analysis shows that school suspensions are strongly predictive of future criminal participation.

The second part of the paper investigates whether the crime-age profile is the result of compulsory school attendance. To quantify the causal effect of school attendance on crime and school suspensions, the introduction of the Earning or Learning (EL) education reform in Queensland is exploited. This reform increased the minimum school leaving age from 16 to 17 in 2006. Thus, the effects of compulsory schooling on crime and school suspensions by age 17 can be studied. This analysis relates to the notion that compulsory school attendance may shift juvenile crime from outside to inside the school premises. School leaving age (SLA) reforms typically mandate school attendance at a critical age when the likelihood of committing crime is highest (Quetelet, 1831; Landersø et al., 2016), and impact the subpopulation of compliers with the lowest ability or desire to stay on at school. Insofar as potential criminals plausibly originate from the bottom of the skill distribution (Machin and Meghir, 2004), the concern emerges that the crime-reducing effect of school documented to date may be over-estimated due to under-reporting of in-school crime.

Juveniles forced by the EL reform to stay on at school for one more year committed less property crime and less drugs crime offences than the control group juveniles who reached the minimum school leaving age prior to 2006. However, they received more school suspensions for property and physical misconduct in school by age 17. A simulation exercise in which similar criminal offences and school suspensions are added and modelled together suggests that forcing juveniles to remain in school has a net crime-reducing effect for both property and drugs offences, i.e., even after accounting for the increase in school suspensions for property misconduct. Once behaviour in school is considered, the property crime-reducing effect of school is smaller than police records alone would suggest. Thus, while these results confirm the conclusion from previous studies

that school attendance reduces crime, they also suggest that omission of in-school discipline records may lead to an over-estimate of the magnitude of the crime-reducing effect of school.[8] This analysis also shows that compulsory schooling may generate a net increase in violence among juveniles, a finding consistent with the concentration effect of school on crime shown in Jacob and Lefgren (2003).

The final part of the paper investigates whether suspensions in secondary school can themselves affect the future criminal behaviour of juveniles. To this end, the panel dimension of the data and the within-individual variation in types of crime and school suspensions are exploited to test whether school suspensions at age 15 to 17 of a particular type predict crime at age 18 to 24 of the same type after controlling for individual fixed effects. The results show that school suspensions at age 15 to 17 and crime at age 18 to 24 of the same type are positively correlated. This indicates, for example, that the likelihood of receiving a school suspension for property misconduct at age 15 to 17 and the likelihood of committing property crime at age 18 to 24 are positively correlated. However, when individual fixed effects are included in the analysis, school suspensions at age 15 to 17 of a given type no longer predict future crime of the same type at the extensive margin, and they negatively predict crime of the same type at the intensive margin. Disciplinary sanctions appear to have a crime-reducing effect for serial offenders but not for the marginal offender. For example, this implies that the receipt of school suspensions for property misconduct at age 15 to 17 reduces the count of property crime offences of serial offenders at age 18 to 24.

Bayer, Hjalmarsson and Pozen (2009) show that incarcerated juveniles who are exposed to peers with experience in a specific type of crime are more likely to commit the same type of crime after release from prison, showing that specific crime skills can follow their own trajectories that need not co-evolve with those of other crime skills. Our analysis shows that receipt of discipline sanctions

[8] Gilpin and Pennig (2015) constitutes an early attempt to study the potential displacement of crime induced by school leaving age reforms. However, these authors use school-level survey data and, therefore, are unable to investigate and indeed exploit any within-school variation at the individual level. Their event-study estimates do not retrieve any effect of compulsory school attendance on in-school crime.

for a particular type of misconduct reduces the likelihood of committing the same type of crime after secondary school. While arrested and incarcerated juveniles are significantly less likely to graduate from high school (Hjalmarsson, 2008) and significantly more likely to be re-arrested and re-incarcerated either in youth or in adulthood (Mendel, 2011; Aizer and Doyle, 2015; and Stevenson, 2017), schools seem to internalise the bad behaviour of juveniles with disciplinary sanctions having a beneficial crime-reducing effect. This internalisation of juvenile misbehaviour and the crime-reducing role of school discipline sanctions is one novel and previously undocumented means by which compulsory school attendance may decrease juvenile crime.

The main takeaway from this paper is that schools internalise the bad behaviour of ESE juveniles when forced to stay on at school, and the use of discipline sanctions in school may reduce the future criminal activity of serial offenders. Cook and Kang's (2016) and Landersø et al.'s (2016) studies are closest to ours as they study the impact of school starting age on crime and present results consistent with an incapacitation effect of school on crime from the US and Denmark respectively. Our analysis adds to these studies in three ways. First, by examining the behaviour of ESE juveniles in secondary school; second, by exploiting a policy change influencing all juveniles to quantify the impact of compulsory schooling on the crime age profile; and third, by studying the effect of school disciplinary sanctions on future criminal activity.

The remainder of the paper is structured as follows. Section 2 describes the institutional setting of this study and presents the RDD analysis of the impact of ESE status on crime and school suspensions in secondary school. Section 3 exploits a policy change to examine the impact of school attendance on crime and discipline sanctions in school. Section 4 studies the impact of school suspensions by age 17 on future criminal activity. Section 5 concludes.

2. Early School Eligibility, School Indiscipline and Crime

The institutional setting of this study is the state of Queensland in Australia. In the last couple of decades, offender rates in Queensland have closely resembled the Australian national average, thus

making the state representative of Australia as a whole (Australian Bureau of Statistics).[9] In Queensland, approximately three quarters of students attend the state-run school sector, which is funded by the Queensland State and Federal Australian Governments (QGOV, 2018a). The remainder of students attend private schools. In Queensland children attend up to 12 years of education (grades 1 to 12), with primary school consisting of grades 1 to 7 and high school consisting of grades 8 to 12. At the end of secondary school, students are expected to sit high-stakes exams to obtain an Overall Position (OP) certificate.

The school year in Queensland runs from the third week of January to mid-December. Administrative rules imply that children are expected to start grade one in the calendar year in which they turn six years old (QGOV, 2018b). This is crucial in the ensuing empirical analysis as it implies that children born one day apart, i.e. December 31st versus January 1st, are expected to start school one year apart. This institutional feature of the Queensland education system is exploited here to define our treatment and control groups and compare their respective criminal propensities.

Data

Queensland State Government administrative data matched at the individual level from two agencies, the Queensland Education Department (QED) and the Queensland Police Service (QPS), are used for this analysis. This dataset includes individual record data for the population of Queensland Government funded school attendees, together with matched individual criminal offence data on juveniles and young adults for the period 2003 to 2014.

Records from the Queensland Police Service (QPS) are used to measure crime. The QPS records refer to alleged criminal offences in a given year by 15 to 24 year old individuals. An alleged offender is a person who has allegedly committed a crime and has been charged by the police for that offence by arrest, caution or warrant of apprehension. An array of crime measures are considered in the empirical analysis. The main outcome of interest is a general measure of criminal offences, which

[9] These statistics can be accessed on the website of the Australian Bureau of Statistics here.

include property, drugs, violence and other offences by offender in a year. Property offences include criminal damage and theft and handling of stolen goods; violent offences include violence against the person, sexual offences and robbery; other offences include burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, weapon offences, public order offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations, and miscellaneous offences.

The crime data were matched at the individual level to the Queensland schooling data from 2003 to 2014. A major advantage of the data is that education and crime records could be matched at the individual level. School disciplinary absences (SDAs), i.e., school suspension records from the QED, are used to measure disciplinary sanctions in school. SDAs are a set of actions that are available to schools in Queensland to restore discipline. Queensland state school principals may use SDAs in response to serious breaches of school rules and unacceptable school behaviour. Reasons for SDAs include property misconduct, such as destruction or theft of school property or the property of others on the school premises; substance misconduct involving illegal substances, such as drugs; and physical misconduct, including violence against other students or against school personnel. Other less serious types of misconduct that may result in the receipt of an SDA include truancy, persistent disruptive behaviour, verbal and non-verbal misconduct, refusal to participate and substance misconduct involving legal substances, i.e., cigarettes or alcohol (QGOV, 2018c). In any one year, principals can discipline students with multiple short suspensions of 1 to 5 days or with multiple long suspensions of 6 to 20 days.[10] Principals can also expel a student from school in response to extreme and repeated bad behaviour.

Empirical Strategy

In Queensland, the formal age at school start is defined by the timing of birth. Children born either side of the 1st January cut-off are subject to a one-year difference in timing of administratively

[10] The definition of short suspension has been modified in 2015, i.e., after our study period ends, and it now includes suspensions lasting from 1 to 10 days.

determined school start. There is some scope for parents and administrators to deviate from the administrative rules governing school starting age of a child. However in the main, at a given 1st January cut-off, children born in the final months of the prior calendar year (i.e., November-December) will likely start school one year earlier than their counterparts born in January-February of the following year. Juveniles born in November-December are referred to as Early School Eligible (ESE), and their crime and school suspension outcomes are compared to those of juveniles born in January-February.

In practice, only youth born +/- 60 days either side of the 1st January cut-off who are observed at the age of 15 in state-maintained schools in Queensland are included in this analysis. ESE is modeled as a binary variable indicating whether youth *i* was born in November-December (i.e., $\mathrm{ESE} = 1$) or in January-February (i.e., $\mathrm{ESE} = 0$). Alternative plausible bandwidths of 90 and 30 days born either side of the cut-off respectively are used to test robustness of the results. In contrast, juveniles born in the remainder of the calendar year are excluded from this RDD analysis and only brought into the later analyses in Sections 3 and 4. Formally, the OLS equation of interest here can be expressed as follows:

$$Y_{it} = \alpha + \beta_1 * ESE_i + X_i\delta + \gamma + \theta_t + u_i, \quad (1)$$

where Y is the behavioural outcome of juvenile i at age t, γ is an age fixed effect, θ is a set of discontinuity fixed effects (i.e., indicator variables for being born in December 1987-January 1988, December 1988-January 1989, December 1989-January 1990, etc.) and u is the error term. X is a vector of observable characteristics which includes individual-level characteristics, a control for distance in birthday to the 1st January cut-off and its interaction term with ESE_i. Since some autonomy is granted to parents and administrators in the decision to hold children back one year and postpone school entry, the actual relative age in cohort in secondary school of juvenile *i* is likely to be correlated with the error term in (1). Since the actual age of juveniles in secondary school is observed in the data, the structural IV analogue to (1) is also estimated where the actual YINC status at the beginning of secondary school is instrumented using ESE status. In this case, ESE is used as an instrument for

the endogenous YINC status that takes value 1 for juveniles who started secondary school almost one year prior to their 13th birthday (i.e., $\mathrm{YINC} = 1$), and value 0 for those who started in close proximity to their 13th birthday (i.e., $\mathrm{YINC} = 0$).

Table 1 shows the means of our selected behavioural outcomes for the full sample of juveniles and for the subsamples of juveniles born within 90, 60 and 30 days respectively either side of the 1st January cut-off. The proportion of youth charged with a criminal offence or in receipt of a school suspension are shown in columns (1) and (2) respectively, while the average count of criminal offences and school suspensions are shown in columns (3) and (4). The descriptive statistics from the full sample and from the discontinuity samples look very similar, suggesting that the latter are a representative subsample of the former. Approximately 3 percent of juveniles educated in state-maintained schools in Queensland committed at least one criminal offence from age 15 to 24, while almost 7 percent of them received at least one school suspension in secondary school. Approximately 8 criminal offences from age 15 to 24 and 10 suspensions in secondary school were recorded for every 100 juveniles in our data.

Tables A.1 and A.2 in the Appendix also show the means of our selected behavioural outcomes by age and by type of crime and SDA for the sample of 203,355 youths born within 60 days either side of the 1st January cut-off. Both our measures of crime and SDAs are memoryless outcomes that inform the tendency to engage in crime or receive school suspensions at any given age. Thus, for each crime category, Table A.1 shows both the proportion of youth charged with a criminal offence in columns (1) to (5) and the average count of criminal offences in columns (6) to (10) by crime type at a given age. Table A.2 follows the same structure for school suspensions. Table A.1 shows that, for youth in state-maintained schools in Queensland, the likelihood of being charged with a criminal offence displays a quadratic form, increasing up until age 18, falling thereafter and almost halving by age 24. The average count of criminal offences per individual also peaks in the late teens

and falls monotonically in the early twenties.[11] These patterns appear most pronounced for drugs and violent crime. Table A.2 suggests that both the incidence and the average count of school suspensions are highest at age 15 and then decrease steadily with age.

Results

The starting point in the empirical analysis is to show that juveniles born in January-February provide a suitable control group for ESE juveniles born in November-December of the previous year. Table 2 shows a set of balancing tests of the distribution of individual and primary school characteristics across the 1st January cut-off (i.e., the ESE cut-off). All the primary school characteristics considered here were measured in grade 7, i.e., the last year of primary school.[12] Each individual variable in turn was regressed on the ESE indicator, a control of distance in birthday to the 1st January cut-off, their interaction term and discontinuity-specific fixed effects.

Results from OLS and local linear regression specifications are shown in columns (1) and (2) respectively. Both estimation methods suggest males and native speakers to be uniformly distributed across the 1st January discontinuity. The same conclusion applies to the primary school characteristics considered here: i.e., the ICSEA Index and the School Deprivation Index, which proxy for the primary schools' financial resources, the fraction of male and native speakers in class, and the number of classmates in primary school. This suggests that juveniles from the treatment and control groups come from similar socio-economic and ethnic backgrounds. The ESE indicator does not predict the primary school fixed effects either, suggesting that ESE pupils and control pupils do not systematically sort into different schools. Finally, the ESE dummy does not predict whether any of the considered individual and primary school characteristics were missing in the data.

Figure 1 shows a density test of the distribution of juveniles across the ESE cut-off. If parents planned fertility in order to have children just after the cut-off, a disproportionate number of

[11] Similar patterns have been found in France (Quetelet, 1831) and Denmark (Landersø et al., 2016).
[12] When information from primary school was not available, binary variables were created to indicate juveniles for which the information was not available, and missing values were then replaced with zeros.

individuals born just after the 1st January would be observed. This would invalidate our experiment. However, birthdays in our sample exhibit similar birth densities either side of the 1st January cut-off. The null hypothesis of equality in the densities either side of the 1st January cut-off could not be rejected at the 10 percent level, based on the main local linear regression specification with a 60-day bandwidth, a triangular kernel and for both conventional and bias-robust confidence intervals.

Tables 3 and 4 show estimates of the causal effect of ESE status on crime and school suspensions respectively. Results are presented for the extensive margin of crime and school suspensions in columns (1) to (3), and for the extensive and intensive margin of crime and school suspensions in columns (4) to (6). In the former case, the dependent variable is a binary indicator (i.e., 0/1) reflecting whether juvenile *i* committed a criminal offence or received an SDA, while in the latter case the dependent variable is the count of criminal offences or SDAs of juvenile *i*. All estimates are obtained from OLS regression specifications, which include individual-level characteristics, a control of distance in birthday to the 1st January cut-off, its interaction term with ESE_i, age fixed effects and discontinuity fixed effects. Specifications in columns (2) and (5) additionally control for the primary school characteristics listed in Table 2, and columns (3) and (6) report results when primary school-discontinuity fixed effects are also added to the estimating equation.[13] In Tables 3 and 4, results are reported for our general measures of crime offences and school suspensions, which include all crime offences and all SDAs by a juvenile. For all outcomes, results are shown using our preferred 60-day bandwidth, as well as 90-day and 30-day bandwidths either side of the discontinuity. Robust standard errors were clustered at the birthday level in all cases.

The results in Tables 3 and 4 clearly show that ESE juveniles are at greater risk of committing crime by age 24 and being suspended during secondary school. This holds true whether the extensive margin or both the extensive and intensive margin of crime and school suspensions are modelled, suggesting that these effects are not driven by a few unruly juveniles. The comparison of these point

[13] A similar set of fixed effects has been used recently to identify peer effects in school in, e.g., Black, Devereux and Salvanes (2013), Anelli and Peri (2017) and Carrell, Hoekstra and Kuka (2018).

estimates with the overall delinquency prevalence reveals that ESE juveniles are roughly 10 to 19 percent more likely to engage in crime at the extensive margin, and they commit 22 to 27 percent more criminal offences by the age of 24. ESE juveniles also seem roughly 10 to 16 percent more likely to receive SDAs in school at the extensive margin, and they receive 16 to 26 percent more SDAs by the age of 17. Reflecting the fact that sociodemographic characteristics are independent of the date of birth near the 1st January cut-off, the point estimates vary only marginally across specifications and bandwidth selections, and the conclusion that ESE juveniles face a greater risk of committing crime and receiving school suspensions appears robust.

Results were also retrieved using an instrumental variable approach to account for the practice of "academic redshirting", whereby parents or educators may delay enrolling a child into mainstream schooling. Figure A.1 and Table A.3 in the Appendix show that the ESE indicator is a strong predictor of whether a juvenile is young in cohort (YINC) at the beginning of secondary school. The magnitude of the discontinuous jump on the 1st January in the likelihood of being YINC in secondary school in Figure A.1 is very similar to the estimated coefficients in Table A.3. The robust standard errors reported in Table A.3, clustered at the birthday level in all specifications, confirm that the ESE status is a strong predictor of YINC status. Although a considerable fraction of ESE juveniles are held back one year, ESE juveniles are much more likely to be YINC in secondary school.[14]

Tables A.4 and A.5 in the Appendix show the IV results for criminal offences and SDAs respectively and follow the same structure of Tables 3 and 4, with the same set of control variables progressively added to the estimating equation. Results are shown for the extensive margin of crime and school suspensions, as well as the combined extensive and intensive margins. Regardless of the equation specification and bandwidth selection, YINC juveniles are much more likely to commit crime by age 24 and receive suspensions during secondary school. This is consistent with the results

[14] Since no youths in the data start secondary school more than one year before or after the date at which they are supposed to start, the ESE instrument monotonically increases the likelihood of being YINC in secondary school. Thus, the monotonicity assumption is satisfied.

in Tables 3 and 4, and it remains valid once the leeway granted to parents and educators in Queensland to defer school enrolment is considered. YINC juveniles are at least 40 percent more likely to engage in crime at the extensive margin, and they commit beyond 64 percent more criminal offences by age 24. YINC juveniles have more than a 40 percent greater chance of receiving SDAs in school at the extensive margin, and they receive roughly 68 percent more SDAs by age 17. These results are large and they appear comparable in magnitude to Cook and Kang (2016), as these authors find a 0.53 discontinuity in the grade level at age 15 and roughly a 0.33 discontinuity in the probability of a delinquent complaint for ESE juveniles by age 15 in North Carolina (thus, the implicit Wald estimator in their case would retrieve a 0.33/0.53 = 0.62 effect).

Results were also estimated using a local linear regression with a triangular kernel. Table A.6 in the Appendix shows that the conclusion that ESE and YINC juveniles face a greater risk of committing crime and receiving SDAs is robust to estimation method, as results are consistent when using either parametric or non-parametric estimation methods. Table A.7 in the Appendix also shows robustness of this conclusion to sample attrition. Table A.1 in the Appendix shows that not all juveniles are observed from age 15 to 24: while some individuals may have genuinely migrated out of Queensland or died, in most cases individuals for whom information is not available until age 24 were simply too young to be observed until age 24. Both the ESE and YINC impact on crime and SDAs were re-estimated only on the sample of 57,330 juveniles that could be observed continuously from age 15 up until age 24. A greater likelihood to commit crime by age 24 still appears here, suggesting that our results are not driven by the potential non-random attrition of ESE juveniles.

Discipline Sanctions and the Crime Age Profile

ESE juveniles are at greater risk of committing crime by age 24 and at greater risk of receiving SDAs up until age 17. One way to derive insights on the role school attendance may play in the determination of these outcomes is to recalculate results separately by age. Figures 2 and 3 break down crime offences and SDAs by age, with Figure 2 showing the results for the extensive margin of crime and SDAs and Figure 3 showing the results for the combined extensive and intensive margins

of crime and SDAs respectively. Equation (1) was estimated separately at each age and for each outcome of interest, and again all specifications included distance to the 1st January cut-off, a pre-cut-off indicator (Nov-Dec = 1), their interaction term, discontinuity fixed effects and controls for individual characteristics. Robust standard errors were clustered again at the date of birth level in all cases.

At age 15, no discrepancy appears between ESE and control group juveniles in their propensities to commit crime and be suspended from school. However, a steep increase in the likelihood of being suspended from school for ESE juveniles appears at the ages of 16 and 17. In contrast, ESE juveniles are no more likely to commit crime until they turn 18, when they are older than the minimum school leaving age. At age 18, ESE juveniles start to commit more crime and they remain significantly more likely to commit crime at all ages until age 24, when the data terminate. Very similar results were obtained from IV regression specifications, and results are shown in Figures A.2 and A.3 in the Appendix. While ESE (YINC) juveniles do not appear to face a greater risk of committing crime until they turn 18, they are significantly more likely to receive SDAs since age 16 in secondary school. As soon as they turn 18, when the legislation governing compulsory school attendance is no longer binding, they face a significantly greater risk of committing crime that persists until the end of the crime-age profile.

Are the ESE juveniles who receive suspensions in secondary school the same individuals who commit crime? To address this question, the results in Tables 3 and 4 were recalculated separately for each ESE juvenile. A separate OLS regression comparing each ESE juvenile with the control group was estimated for school suspension and crime at the extensive margin. The estimated youth-specific effects were grouped in percentiles, and Figure 4 shows the average percentile youth-specific effects of ESE status on crime by percentile youth-specific effects of ESE status on school suspension. The Figure plots average percentile youth-specific ESE effects on crime against percentile youth-specific ESE effects on school suspension. A strong positive correlation appears between percentile effects of ESE status on crime and school suspension, with the linear fit of the scatterplot being 0.24

and strongly statistically significant. This shows that the juveniles born at the end of the calendar year who commit more crime are to a large extent the same juveniles more likely to experience school suspension by age 17.

3. Compulsory School Attendance, Discipline Sanctions and the Crime Age Profile

The educational experience of juveniles and its impact on their behaviour in and out of school are of central interest to this paper. The results in Section 2 clearly show that ESE juveniles are more likely to engage in crime and be disciplined at school. An incapacitation effect of school attendance on crime is suggested by the findings in Figures 2 and 3, as they show ESE juveniles switching from bad behaviour in school to crime at age 18. ESE juveniles may be induced to behave poorly inside school until age 18 because they are forced to stay on at school. The positive correlation in Figure 4 is also consistent with the notion that schools internalize the bad behaviour of juveniles at risk, as the same juveniles seem to receive suspensions from school as well as commit future crime.

Empirical Strategy

One way to test whether this crime age profile is the result of the existing compulsory schooling law is to exploit the impact on crime and school suspensions of a recent reform, i.e., the Queensland's Earning or Learning (EL) Reform, which modified the legislation governing school leaving behaviour in Queensland in 2006. Prior to 2006, school attendance was mandatory until either completing grade 10 or turning 16 years old, whichever occurred first. The EL reform raised the minimum school leaving age from 16 to 17. This additional year of compulsory education either had to be spent in school, in vocational training, or in a full-time job. The EL reform introduced a compulsory participation obligation forcing juveniles to participate in a range of activities broadly defined as "earning or learning" for up to an additional two years, or until they turned 17 years old. Juveniles were forced to either stay on at school until obtaining a high school Senior Certificate or a vocational education Certificate III, or to participate in paid employment for at least 25 hours per week until age 17.

Since the first cohort to be affected by the reform was born in 1990, the full sample of juveniles born at any point in time from 1987 to 1992 was used for this exercise. The same exercise was also restricted to the subsample of juveniles that were born from 1987 to 1992 within 60 days either side of the 1st January cut-off. Since our data starts in 2003, the 1987 cohort is the earliest cohort that can be observed at the age of 16. Formally, the impact of the EL reform on school leaving behaviour, crime and school discipline sanctions can be estimated using OLS as follows:

$$Y_i = \alpha + \beta_2 * EL + X_i\delta + \vartheta + \omega_i, \quad (2)$$

where *Y* is school leaving grade, crime or SDA of individual *i* by age 17. *EL* is a binary variable that takes up value 1 for juveniles born in 1990-92 who were subject to the EL reform, and value 0 for juveniles born in 1987-89. In (2), estimates of β_2 show the impact of the EL reform on the school leaving behaviour, crime and school behaviour of juveniles by age 17, ϑ is a set of age fixed effects, *X* represents a vector of individual characteristics and ω is the error term. Standard errors were clustered at the year of birth level and, due to the small number of clusters, the Wild Cluster Bootstrap approach suggested in Cameron, Gelbach and Miller (2008) was used for inference.

Results

Table 5 shows the result of the analysis for all types of crime and SDA, while Tables 6, 7 and 8 present results separately for property, drugs and violent offences respectively. In Tables 5 to 8, the upper panel shows results for the full sample of juveniles born from 1987 to 1992, while the lower panel shows results for juveniles born 60 days either side of the 1st January cut-off in the same years. In all Tables, column (1) shows the first order effect of the EL reform on the school leaving behaviour of juveniles in Queensland, and the same estimates are presented for convenience in column (1) of all Tables. They show that, while juveniles in Queensland used to leave school in between grade 11 and grade 12 prior to the EL reform, this reform resulted in roughly half a year of additional school attendance on average. These results appear consistent between the full sample, shown in the upper panel, and the sample born 60 days either side of the 1st January cut-off, shown in the lower panel of the Tables. Columns (2) and (3) show the unintended impact of the EL reform on the extensive margin

of crime and school suspension, while columns (4) and (5) show its impact on both the extensive and intensive margins of crime and school suspension. In columns (6) and (7), the dependent variables are the sum of crime records and SDAs in school. This simulation exercise is conducted to study the extent to which the potential increase in indiscipline in school may counteract any crime reduction effect of school. In each Table, column (6) shows the net effect of the EL reform on crime at the extensive margin, while column (7) shows the net effect of the EL reform on the count of crimes at the extensive and intensive margins.

Estimates in Table 5 show that criminal participation of juveniles forced to stay at school for one more year by the EL reform reduced both at the extensive and intensive margin. However, an increase in the count of school suspensions is also observed for juveniles forced to stay at school for longer, suggesting that the EL reform moved the bad behaviour of unruly juveniles from outside to inside the school. These results appear consistent between the full sample, shown in the upper panel, and the sample born 60 days either side of the 1st January cut-off, shown in the lower panel. The EL reform reduced the likelihood of committing a crime by 21 percent in the full sample and by 13 percent in the sample born 60 days either side of the 1st January cut-off, while the likelihood to receive a school suspension increased by roughly 30 percent in both samples. While the count of crimes decreased by 20 to 25 percent for the cohorts exposed to the EL reform, the count of school suspensions increased by 37 to 38 percent. Columns (6) and (7) show that, when school suspensions are also considered, no significant crime-reducing effect of the EL reform can be detected. Compared with the estimates in columns (2) and (3), the estimated coefficients in columns (6) and (7) are also much smaller fractions of the means of the dependent variables prior to the reform. This is of course a worst-case scenario and in-school crime must be overestimated, as not all school suspensions considered here are actually crimes, but it suggests that the omission of school discipline sanctions from the analysis of previous studies may have over-estimated the crime-reducing effect of compulsory education.

Table 6 shows the results for property crime and school suspensions for property misconduct. Columns (2) and (4) respectively show that the EL reform reduced participation in property crime at the extensive margin by 18 percent and the count of property crime incidents by 27 percent. Columns (3) and (5) show that the EL reform resulted in a 60 percent increase in school suspensions for property misconduct among juveniles who were directly affected by the EL reform. As columns (6) and (7) show, this increase in in-school indiscipline does not wipe out the net property crime-reducing effect of school, but it reduces the magnitude of the effect. Column (7) suggests that, when in-school property misconduct is also considered, the EL reform did not reduce the count of property crime incidents by 27 percent, as suggested by column (4), but rather by a smaller 20 percent.

Results for drugs offences and school suspensions for illicit substances are presented in Table 7. Here a crime-reducing effect of the EL reform appears again, while no increase in school suspensions for illicit substances could be detected. Both the likelihood to commit a drugs offence and the count of drugs offences committed by juveniles up to age 17 reduced by 45 percent. As columns (6) and (7) show, when drugs offences and school suspensions for illicit substances are considered together, a 40 percent net crime-reducing effect of the EL reform appears both at the extensive and at the intensive margin. A different conclusion emerges from Table 8, where estimates for violent crime and school suspensions for physical misconduct are presented. Exposure to the provisions of the EL reform did not affect violent crime. However, as Columns (3) and (5) of Table 8 show, it increased school suspensions for violent misconduct by roughly 40 percent both at the extensive and at the intensive margin. Columns (6) and (7) show that, when violence records outside and inside school are considered together, a net 28 percent increase in violent behaviour is found at the extensive and intensive margin.

4. Discipline Sanctions and Future Criminal Participation

The analysis of the EL reform confirms that compulsory school attendance reduces crime in the short run. However, this analysis also suggests that schools internalise bad behaviour, i.e., with juveniles

being unable to commit crime outside school when they are forced to stay in school. When in-school behaviour is considered, evidence of net reductions in property offences and drug offences still appear, while the incidence of violent offences in school increases. While an incapacitation effect of school on property crime and drugs crime is the likely driver of the net crime reductions in Tables 6 and 7, a concentration effect resulting in a net crime increase seems to be at play for violent crime (see Jacob and Lefgren, 2003). These findings suggest that the crime-age profiles in Figures 2 and 3 are, at least in part, the results of mandatory school attendance: schools internalise the bad behaviour of ESE juveniles, as reflected by their school suspensions, until students reach the minimum school leaving age. While they are in school, ESE juveniles are no more likely to commit criminal offences than others. As soon as they leave school, ESE juveniles become more likely to commit criminal offences up until age 24 when the analysis terminates.

The analyses in Sections 2 and 3 raise the question of whether school suspensions during secondary school have any implications for the future criminal participation of juveniles. In particular, the analyses presented so far are not informative on whether school suspensions in secondary school and crime simply reflect similar unobservable predetermined characteristics of juveniles or whether the adoption of behavioural rules and the use of discipline sanctions in school may actively contribute to the education production function and thus affect the future criminal behaviour of juveniles (Lazear, 2001). The importance of behavioural norms and work ethic, strict behavioural expectations and severe disciplinary codes in school has been appraised in several recent empirical studies (Abdulkadiroglu et al., 2011; Dobbie and Fryer, 2011; Angrist et al., 2016; Dobbie and Fryer, 2015, 2016; and Machin and Sandi, forthcoming).

Our study contributes to this debate by examining the effect of discipline sanctions in school on future crime once time-invariant individual-specific unobservable characteristics have been considered. The hypothesis here is that, since discipline sanctions in school are part of the educational offer of schools, they are often handled by school principals and they do not usually result in the arrest of the unruly juvenile, they should have a negative effect on the likelihood to commit crime in

the future. In addition to decreasing contemporaneous crime via an incapacitation effect, compulsory school attendance may also actively reduce future criminality by internalising the trouble generated by juveniles at risk and precisely by disciplining unruly juveniles.

Empirical Strategy

The current section of the paper tests this hypothesis by exploiting within-juvenile variation by type of crime and type of school suspension. Three types of crime and school suspensions are observable in the data, namely property crime and SDAs, drugs crime and SDAs, and violent crime and SDAs. Thus, criminal activity at age 18-24 by crime type can be modelled on SDAs at age 15-17 by type and individual fixed effects. For this analysis, a dataset with three observations per juvenile was constructed, i.e., one observation for each type of crime/SDA by individual. Once the inherent individual-specific propensity to commit crime is controlled for via inclusion of individual fixed effects, the estimated coefficient for school suspensions at age 15-17 is identified with the remaining within-individual crime-/SDA-specific variation. This analysis should reveal whether school suspensions of a certain type (e.g., property crime) during compulsory schooling age have an impact on future criminal activity of the same type (e.g., property crime).[15] Our estimating equation can be expressed as follows:

$$Y_{i\tau 18-24} = \alpha + \beta_3 * SDA_{i\tau 15-17} + i + \tau + \epsilon_i, \quad (3)$$

where $Y_{i\tau 18-24}$ measures participation in criminal activity type τ of juvenile i from age 18 to 24. In (3), $SDA_{i\tau 15-17}$ is the count of school suspensions of type τ from age 15 to 17, i is a set of individual fixed effects, τ is a set of crime/suspension type fixed effects, and ϵ is the error term. This analysis was conducted on all juveniles that could be observed continuously from age 15 in state-maintained schools in Queensland up until age 18 or older. Standard errors were clustered at the individual level for inference.

[15] A similar approach is used in Murphy and Weinhardt (2018) to study the impact of relative ranking in primary school on future school performance. In their setting, since grades in three subjects (English, Maths and Science) are available for each student in primary and secondary school, within-individual variation in primary school ranking and future school performance by subject can be exploited.

Results

Table 9 shows the results of this exercise. Columns (1) to (3) display the results for the extensive margin of criminal activity from age 18 to 24, while Columns (4) to (6) display the results for both the extensive and intensive margin of criminal activity from age 18 to 24. The upper panel shows the results for the full sample and the lower panel shows results for the subsample of individuals born within 60 days either side of the 1st January cut-off. Columns (1) and (4) show results without controlling for individual fixed effects, as controls are only included for individual characteristics, year of birth fixed effects and crime type fixed effects. All other columns additionally include individual fixed effects, with Columns (5) and (6) also controlling for count of crime records of type τ from age 15 to 17.

Columns (1) and (4) show a strong positive correlation between criminal activity at age 18 to 24 and school suspensions at age 15 to 17. This is consistent with the results in Figure 4 for ESE juveniles. However, when individual fixed effects are included in the estimating equation, no significance appears in Columns (2) and (3). As inclusion of individual fixed effects allows us to give a more causal interpretation to the estimated coefficients, this suggests that school suspensions do not affect future criminal participation at the extensive margin. In Columns (5) and (6), where both the extensive and intensive margins of crime are studied, the coefficients associated with school suspensions appear negative and significant. As individual fixed effects are controlled for here, this suggests that receiving discipline sanctions in school for misconduct of a certain type (e.g., property misconduct) by age 17 reduces the count of offences of the same type (e.g., property crime) at age 18 to 24 over and above one's inherent propensity to receive school discipline sanctions and commit crime. These conclusions do not change in Column (6), where crime records and school suspensions at age 15 to 17 are included in the same specification and estimated together. Estimates in Columns (5) and (6) suggest that school suspensions reduce the count of future criminal offences by at least 26 percent.

5. Conclusion

A large literature has documented the disadvantage stemming from early school eligibility. This has been shown to affect the path of skills acquisitions, school grades since childhood and, more recently, criminal participation. However, very little is known about the educational experience of early school eligible juveniles and how this can affect their criminal trajectories. Using administrative data linking education and criminal records of individuals in the state of Queensland in Australia from 2003 to 2014, this study examines the educational experience of these juveniles and its effect on their criminal trajectories.

Juveniles who are born at the end of the calendar year and start school at a younger age are more likely to commit crime as well as to receive discipline sanctions in school. A very clear profile also emerges from the analysis, suggesting that juveniles born at the end of the calendar year are more likely to receive school suspensions by age 17 and then start to commit more crime post-compulsory schooling at age 18. Derivation of individual-specific estimates also shows that, to a large extent, the same juveniles receive school suspensions in secondary school and commit criminal offences by age 24.

Availability of a recent school leaving age reform allows us to test whether this pattern can be causally attributed to compulsory schooling. The analysis shows that, when juveniles are forced to stay at school for one additional year, an overall reduction in crime is observed. This is driven by reductions in property crime and drugs crime, while violent crime remains unaffected. However, when juveniles at risk are forced to stay at school for another year, a sizeable increase in disciplinary sanctions in school is also observed. This is driven by the increase in disciplinary sanctions for property misconduct and physical misconduct. When crime records and school suspensions are considered together, a net reduction in property crime and drugs offences still appears, while violence increases as a result of the lengthened duration of the compulsory schooling period. By quantifying the extent to which schools internalise the bad behaviour of unruly juveniles when these are forced to stay at school for longer, this analysis also addresses the concern that the crime-reducing effect of

school documented to date may be the artificial result of systematic under-reporting of in-school crime to the police.

Additional statistical tests reveal that, once unobservable time-invariant individual-specific characteristics are considered, the receipt of discipline sanctions in school for a certain type of misconduct has a negative effect on future criminal participation of the same type. Thus, the overall conclusion of this study is that schools internalise the bad behaviour of unruly juveniles when these are forced to stay on at school, and the use of discipline sanctions in school can reduce the future criminal activity of serial offenders. This underlines the fact that education policy can reduce youth crime participation not just by keeping juveniles off the streets, but also by disciplining them in school. Whether an adolescent at risk is forced to stay in school or not does shift trouble from outside to the school premises, and compulsory education can play an active role in reducing crime. Generating an understanding of the education experience and how it affects adolescents at risk and their criminal behaviour is a step toward helping them avoid getting caught in the revolving door between poor school performance, juvenile delinquency and future incarceration.

References

Abdulkadiroglu, A., Angrist, J., Dynarski, S., Kane, T. and Pathak, P. (2011). Accountability and Flexibility in Public Schools: Evidence From Boston's Charters and Pilots, Quarterly Journal of Economics, 126, 699-748.

Aizer, A., and Doyle, J. J. Jr. (2015). Juvenile Incarceration, Human Capital and Future Crime: Evidence from Randomly-Assigned Judges. Quarterly Journal of Economics 130, 759–803.

Anderson, D. (2014). In School and Out of Trouble? The Minimum Dropout Age and Juvenile Crime, Review of Economics and Statistics, 96, 318-31.

Anelli, M. and Peri, G. (2017). The Effects of High School Peers' Gender on College Major, College Performance and Income, The Economic Journal, doi:10.1111/ecoj.12556.

Angrist, J., Cohodes, S., Dynarski, S., Pathak, P. and Walters, C. (2016). Stand and Deliver: Effects of Boston's Charter High Schools on College Preparation, Entry, and Choice. Journal of Labor Economics, 34, 275-318.

Australian Bureau of Statistics (2017). Recorded Crime – Offenders for the year 2015-16. http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4519.0~2015-16~Main%20Features~Youth%20offenders~4

Bayer, P., R. Hjalmarsson and Pozen, D. (2009) Building Criminal Capital behind Bars: Peer Effects in Juvenile Corrections, Quarterly Journal of Economics, 124, 105–147.

Beatton, D., Kidd, M., Machin, S.J. and Sarkar, D. (2017). Larrikin Youth: Crime and Queensland's Earning and Learning Reform. Labour Economics, Volume 52, June 2018, Pages 149-159.

Bedard, K. and Dhuey, E. (2006). The Persistence of Early Childhood Maturity International Evidence of Long-Run Age Effects. Quarterly Journal of Economics, 121, 1437-1472.

Bell, B., Costa, R. and Machin, S. (2016). "Crime, Compulsory Schooling Laws and Education", Economics of Education Review, 54, 214-26.

Bell, B., Costa, R. and Machin, S. (2018). "Why Does Education Reduce Crime?", IZA Discussion Paper No. 11805.

Black, S., Devereux P. and Salvanes, K. (2011). Too young to leave the nest? The effects of school starting age. Review of Economics and Statistics; 93: 455–467.

Black, S., Devereux, P. and Salvanes, K. (2013). Under Pressure: The Effect of Peers on Outcomes of Young Adults. Journal of Labor Economics, vol. 31, no. 1.

Cameron, C., Gelbach, J. and Miller, D. (2008). Bootstrap- Based Improvements for Inference with Clustered Errors. Review of Economics and Statistics, 90(3):414–27.

Carrell, S. E., Hoekstra, M. and Kuka, E. (2018). The Long-Run Effects of Disruptive Peers. American Economic Review, 108 (11): 3377-3415.

Cook, P.J. and Kang, S. (2016). Birthdays, Schooling, and Crime: Regression-Discontinuity Analysis of School Performance, Delinquency, Dropout, and Crime Initiation. American Economic Journal: Applied Economics, 8(1): 33–57

Crawford, C., Dearden, L. and Meghir, C. (2010). When you are born matters: the impact of date of birth on educational outcomes in England. Working Paper 10/06. London: Institute for Fiscal Studies.

Cunha, F. and Heckman, J. (2008). Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation. Journal of Human Resources, 43, 738–782.

Datar, A. (2006). Does delaying kindergarten entrance give children a head start? Economics of Education Review, 25, 43–62.

Depew, B. and Eren, O. (2016). Born on the wrong day? School entry age and juvenile crime. Journal of Urban Economics, vol. 96, November 2016, pp. 73-90.

Dobbie, W. and Fryer, R. (2011). Are High Quality Schools Enough to Close the Achievement Gap? Evidence From a Social Experiment in Harlem, American Economic Journal: Applied, 3, 158–87.

Dobbie, W. and Fryer, R. (2015). The Medium-Term Impacts of High-Achieving Charter Schools, Journal of Political Economy, 123, 985-1037.

Dobbie, W. and Fryer, R. (2016). Charter Schools and Labor Market Outcomes, National Bureau of Economic Research Working Paper No. 22502.

Elder, T.E. and Lubotsky, D.H. (2009). Kindergarten entrance age and children's achievement: impacts of state policies, family background, and peers. Journal of Human Resources, vol. 44(3), pp. 641-83

Gilpin, G. A. and Pennig, L. A. (2015). Compulsory schooling laws and school crime. Applied Economics, 47:38, 4056-4073, DOI: 10.1080/00036846.2015.1023944

Hjalmarsson, R. (2008). Criminal justice involvement and high school completion. Journal of Urban Economics, 63, 613–30. doi:10.1016/j.jue.2007.04.003

Hjalmarsson, R., Holmlund, H., and Lindquist, M. (2015). The Effect of Education on Criminal Convictions and Incarceration: Causal Evidence from Micro-Data. Economic Journal, 125, 1290-1326.

Jacob, B. and Lefgren, L. (2003). Are Idle Hands the Devil's Workshop? Incapacitation, Concentration and Juvenile Crime. American Economic Review, 93, 1560-77.

Landersø., R., Nielsen., H.S. and Simonsen, M. (2016). School Starting Age and the Crime-Age Profile. The Economic Journal, 127, 1096–1118.

Lazear, E. P. (2001). Educational production, Quarterly Journal of Economics, 116, 777–803.

Lochner, L. and Moretti, E. (2004). The Effect of Education on Crime: Evidence from Prison Inmates, Arrests and Self-Reports. American Economic Review, 94, 155-89.

Luallen, J. (2006). School's Out... Forever: A Study of Juvenile Crime, At-Risk Youths and Teacher Strikes. Journal of Urban Economics, 59:75.

Machin, S., Marie, O. and Vujic, S. (2011). The Crime Reducing Effect of Education. Economic Journal, 121, 463-84.

Machin, S., and Meghir, C. (2004). Crime and Economic Incentives. Journal of Human Resources 39(4): 958-79.

Machin, S., and Sandi, M. (forthcoming). Autonomous Schools and Strategic Pupil Exclusion. The Economic Journal

McCrary, J., and Royer, H. (2011). The Effect of Female Education on Fertility and Infant Health: Evidence from School Entry Policies Using Exact Date of Birth. American Economic Review, 101(1): 158-95.

McEwan, P. J., and Shapiro, J. S. (2008). The benefits of delayed primary school enrollment: Discontinuity evidence using exact birth dates. Journal of Human Resources, 43(1), 1–29.

Mendel, R. A. (2011). No Place for Kids: The Case for Reducing Juvenile Incarceration. Annie E. Casey Foundation Technical Report.

Murphy, R. and Weinhardt, F. (2018). Top of the class: The importance of ordinal rank, National Bureau of Economic Research Working Paper No. 24958.

Puhani, P. A. and Weber, A. M. (2007). Persistence of the School Entry Age Effect in a System of Flexible Tracking. IZA Discussion Paper No. 2965; University of St. Gallen Economics Discussion Paper No. 2007-30.

Quetelet, A. (1831) [1984]. Research on the Propensity for Crime at Different Ages, translated and introduced by Sawyer F. Sylvester. Cincinnati: Anderson

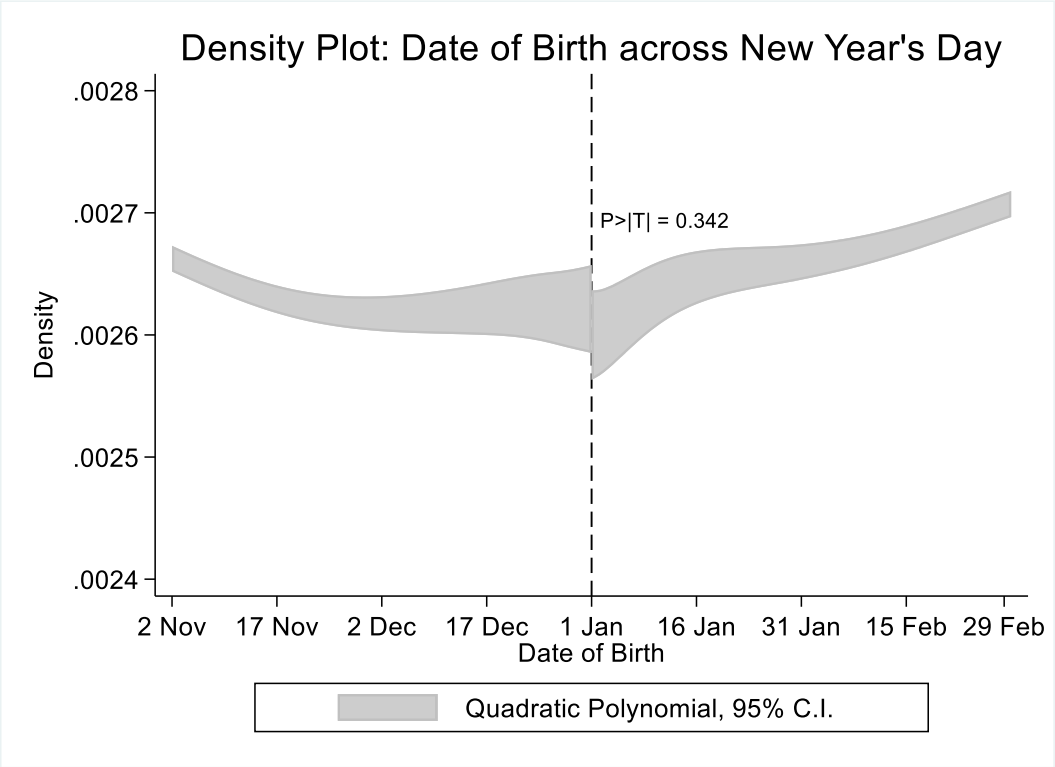
QGOV (2018a). Queensland School System. Queensland State Government. https://www.qld.gov.au/education/international/qualifications/school/pages/system, accessed 30 January, 2018.

QGOV (2018b). Enrolment age requirements. Queensland State Government. https://www.qld.gov.au/education/schools/find/enrolment/pages/age, accessed 30 January, 2018

QGOV (2018c). Strengthening discipline in Queensland state schools. Queensland State Government. http://education.qld.gov.au/schools/strengthening-discipline/, accessed 30 January, 2018.

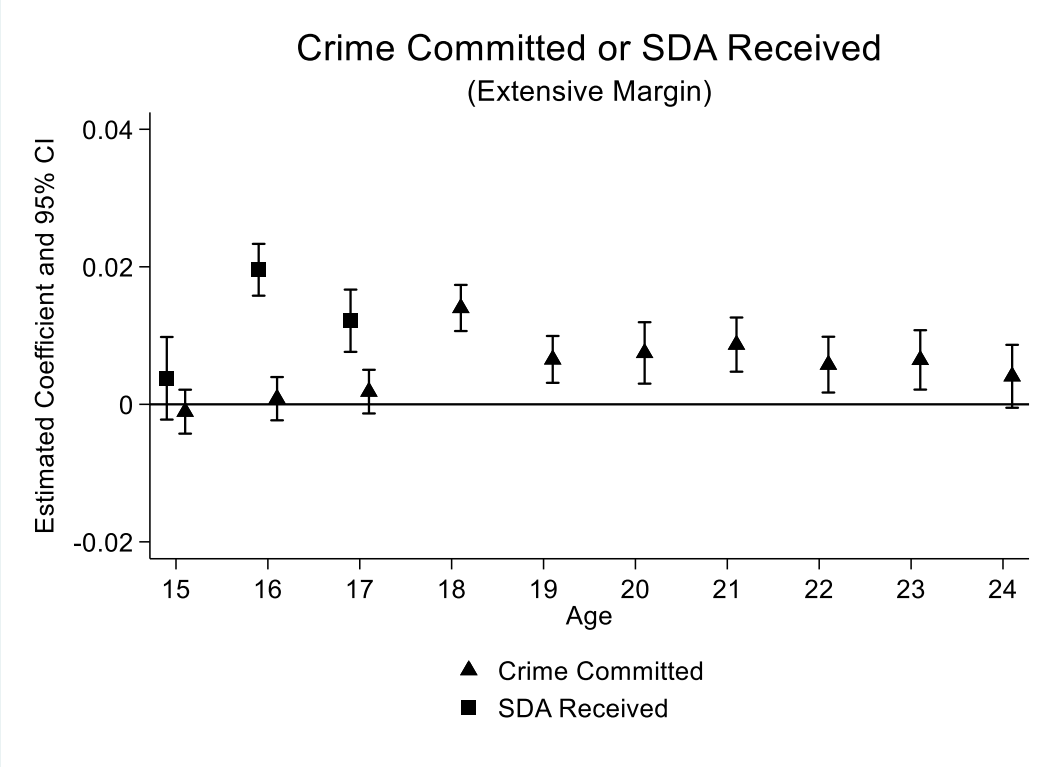
Stevenson, M. (2017). Breaking Bad: Mechanisms of Social Influence and the Path to Criminality in Juvenile Jails. The Review of Economics and Statistics, December 2017, 99(5): 824–838

Figure 1. Density Test of Births Across 1st January Cut-off.



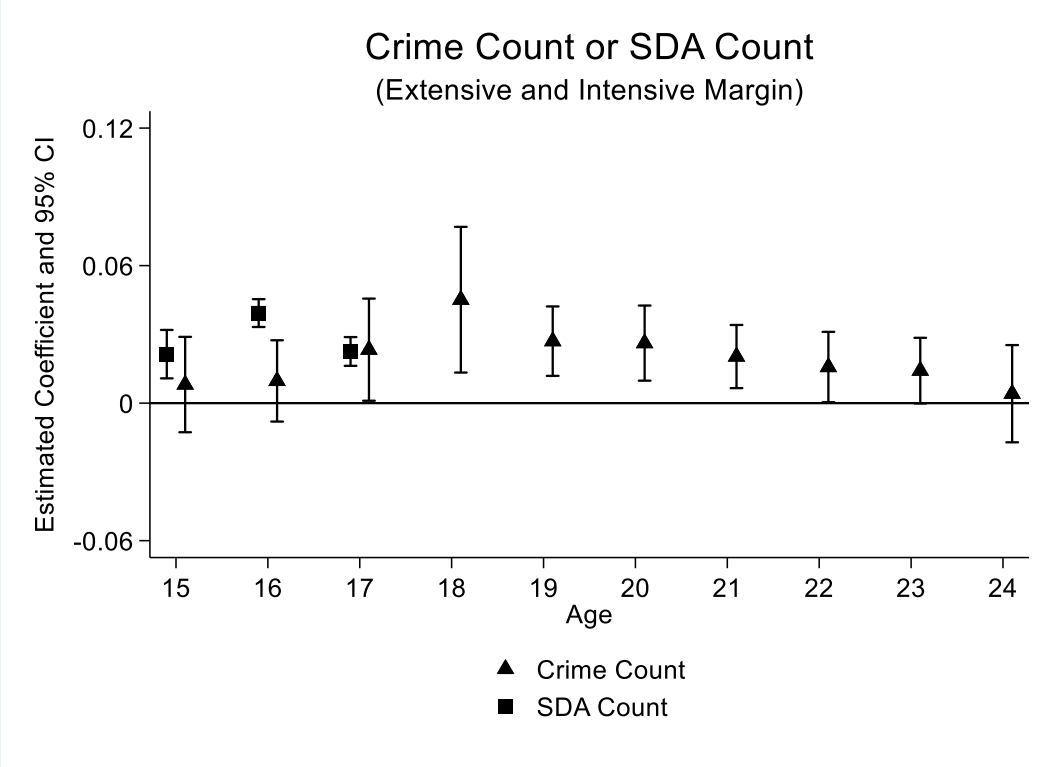
Notes: Horizontal axis represents the date of birth for the sample of youth born within 60 days either side of the 1st January cut-off. The shaded area represents 95 percent bias-robust confidence intervals using a triangle kernel and a 60-day bandwidth. The null hypothesis of equality in the densities either side of the 1st January cut-off could not be rejected at the 10 percent level based on the local quadratic regression specification with a 60-day bandwidth and triangle kernel that is shown here. The null hypothesis of equality in the densities either side of the 1st January cut-off could not be rejected at the 10 percent level also when using a local linear regression specification with a 60-day bandwidth and triangle kernel.

Figure 2. OLS Estimates of ESE Impact on Crime and SDAs by Age at the Extensive Margin.



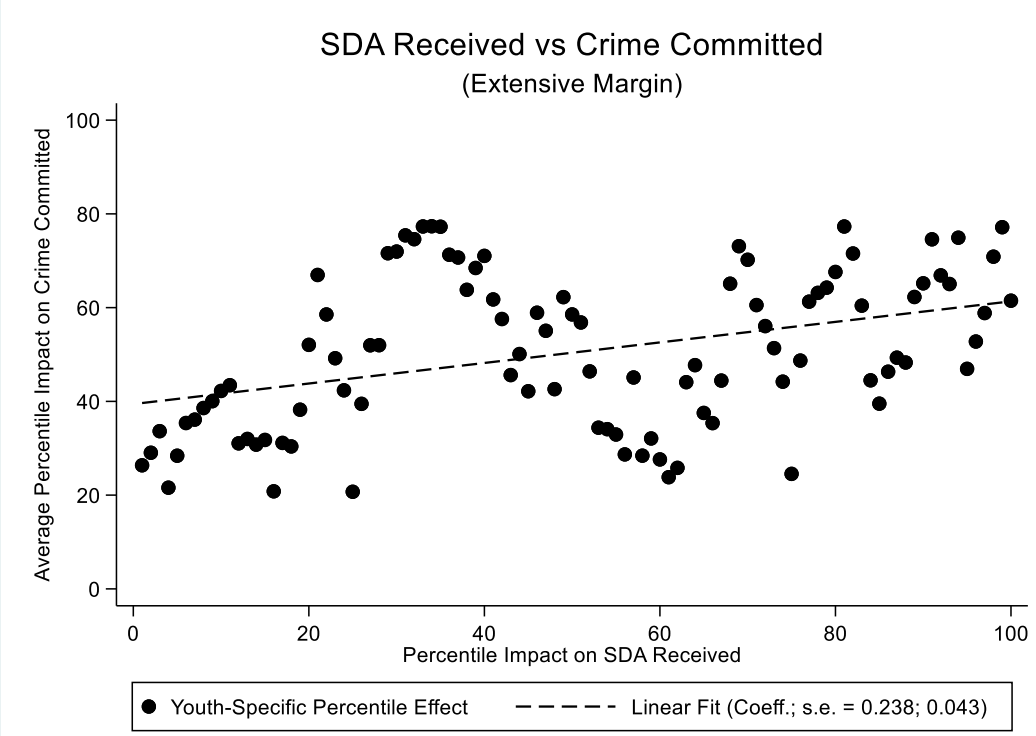
Notes: Figure 2 shows point estimates and 95 percent confidence intervals of the causal effect of early school eligibility (ESE) on the likelihood to commit crime (extensive margin) and on the likelihood to receive a school disciplinary absence (SDA, extensive margin) by age. All estimates are obtained from OLS regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1), their interaction term and discontinuity fixed effects. Robust standard errors were clustered at the date of birth level. Control variables included are dummies for whether the youths are male, whether they are native English speakers and a binary indicator for whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Figure 3. OLS Estimates of ESE Impact on Crime and SDAs by Age at the Extensive and Intensive Margin.



Notes: Figure 3 shows point estimates and 95 percent confidence intervals of the causal effect of early school eligibility (ESE) on the count of crime offences (extensive and intensive margins) and on the count of school disciplinary absences (SDA, extensive and intensive margins) by age. All estimates are obtained from OLS regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1), their interaction term and discontinuity fixed effects. Robust standard errors were clustered at the date of birth level. Control variables included are dummies for whether the youths are male, whether they are native English speakers and a binary indicator for whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Figure 4. Average Youth-Specific Percentile Estimates of ESE Impact on Crime by Youth-Specific Percentile Estimates of ESE Impact on SDAs.



Notes: Figure 4 shows average percentile youth-specific OLS estimates of the causal effect of early school eligibility (ESE) on the likelihood to commit crime (extensive margin) by percentile youth-specific OLS estimates of the causal effect of ESE on the likelihood to receive school disciplinary absences in secondary school (SDAs, extensive margin). A linear function fitting the distribution of youth-specific OLS estimates is also shown in Figure 4, and the legend reports its OLS coefficient and standard error. For each youth in the analysis, the horizontal axis shows the percentile OLS estimate of the causal effect of ESE on SDAs in secondary school, whereas the vertical axis shows the average percentile youth-specific OLS estimates of the causal effect of ESE on crime. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Table 1. Means of Selected Behavioural Outcomes.

	Crime Committed	SDA Received	Crime Count	SDA Count
	(Extensive Margin)		(Extensive and Intensive Margin)	
	(1)	(2)	(3)	(4)
Mean	0.031	0.068	0.083	0.103
No. Youths (Full Sample)	636061	636061	636061	636061
Mean	0.031	0.068	0.081	0.104
No. Youths (90 days Bandwidth)	308628	308628	308628	308628
Mean	0.031	0.069	0.081	0.105
No. Youths (60 days Bandwidth)	203355	203355	203355	203355
Mean	0.031	0.069	0.080	0.107
No. Youths (30 days Bandwidth)	101285	101285	101285	101285

Notes: Table 1 shows means of selected behavioural outcomes. All crimes includes property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. All school disciplinary absences (SDAs) includes property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Table 2. Balancing of Individual and Primary School Characteristics across the 1st January Cut-off.

	Impact on ESE status (Nov-Dec = 1) on:	OLS	Local Linear Regression
		(1)	(2)
(1)	Male	-0.001	-0.006
		(0.005)	(0.006)
(2)	Native Speaker	0.025	0.022
		(0.022)	(0.030)
(3)	Not Known Native Speaker	-0.009	-0.002
		(0.012)	(0.017)
(4)	ICSEA in final year of Primary School (X 100)	-1.210	45.641
		(3.607)	(298.68)
(5)	Not Known ICSEA in final year of Primary School	0.001	-0.046
		(0.004)	(0.304)
(6)	SD Index in final year of Primary School (X 100)	-1.305	45.556
		(3.635)	(298.68)
(7)	Not Known SD Index in final year of Primary School	0.001	-0.046
		(0.004)	(0.304)
(8)	Fraction of Male Classmates in final year of Primary School	-0.002	0.023
		(0.002)	(0.156)
(9)	Not Known Fraction of Male Classmates in final year of Primary School	0.001	-0.046
		(0.004)	(0.303)
(10)	Fraction of Native Speaker Classmates in final year of Primary School	0.000	0.044
		(0.003)	(0.283)
(11)	Not Known Fraction of Native Speaker Classmates in final year of Primary School	0.001	-0.046
		(0.004)	(0.303)
(12)	Number of Classmates in final year of Primary School	-0.004	-1.059
		(0.088)	(7.016)
(13)	Not Known Number of Classmates in final year of Primary School	0.001	-0.046
		(0.004)	(0.304)
(14)	Final year of Primary School Fixed Effects	-7.239	46.179
		(8.710)	(323.75)
(15)	Not Known Final year of Primary School Fixed Effects	0.001	-0.046
		(0.004)	(0.304)
	Discontinuity Fixed Effects	Yes	Yes
	Youths	203355	203355

Notes: Presented in each row are the discontinuity estimates of the given variable at the 1st January cut-off date. Estimates in column (1) are obtained from OLS regression specifications where a bandwidth of 60 days is used. Estimates in column (2) are obtained from local linear regression specifications where a triangular kernel with bandwidth of 60 days is used. Robust standard errors are clustered at the date of birth level in rows (1) to (3), and at the primary school level in rows (4) to (15). All specifications include distance to the 1st January cut-off and its interaction term with the pre-cut-off indicator (Nov-Dec = 1). * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 3. Estimates of ESE Impact on Crime.

	Crime Committed (Extensive Margin)			Crime Count (Extensive and Intensive Margin)		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
ESE	0.003***	0.006***	0.005***	0.014***	0.020***	0.019***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)
No. Youths (90 days Bandwidth)	308628	308628	308628	308628	308628	308628
ESE	0.003***	0.005***	0.005***	0.016***	0.022***	0.019***
	(0.001)	(0.001)	(0.001)	(0.005)	(0.005)	(0.005)
No. Youths (60 days Bandwidth)	203355	203355	203355	203355	203355	203355
ESE	0.004**	0.005***	0.004***	0.016**	0.020***	0.016***
	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.005)
No. Youths (30 days Bandwidth)	101285	101285	101285	101285	101285	101285
Primary School Characteristics	No	Yes	Yes	No	Yes	Yes
Primary School x Discontinuity Fixed Effects	No	No	Yes	No	No	Yes
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Discontinuity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table 3 shows estimates of the causal effect of early school eligibility (ESE) on crime. All estimates are obtained from OLS regression specifications. All specifications include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Individual Characteristics variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Primary School Characteristics variables included are calculated in the final year of primary school and they are the School Deprivation Index, the School ICSEA Index, the share of male classmates, the share of English native speaker classmates, the number of classmates and a series of binary indicators for whether the Primary School Deprivation Index is unknown, for whether the Primary School ICSEA Index is unknown, for whether the share of male classmates in the final year of primary school is unknown, for whether the share of English native speaker classmates in the final year of primary school is unknown, and for whether the number of classmates in the final year of primary school is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 4. Estimates of ESE Impact on SDAs.

	SDA Received (Extensive Margin)			SDA Count (Extensive and Intensive Margin)		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
ESE	0.011***	0.011***	0.011***	0.027***	0.027***	0.026***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
No. Youths (90 days Bandwidth)	308628	308628	308628	308628	308628	308628
ESE	0.011***	0.011***	0.011***	0.026***	0.026***	0.025***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
No. Youths (60 days Bandwidth)	203355	203355	203355	203355	203355	203355
ESE	0.008***	0.008***	0.007***	0.019***	0.019***	0.017***
	(0.002)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)
No. Youths (30 days Bandwidth)	101285	101285	101285	101285	101285	101285
Primary School Characteristics	No	Yes	Yes	No	Yes	Yes
Primary School x Discontinuity Fixed Effects	No	No	Yes	No	No	Yes
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Discontinuity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table 4 shows estimates of the causal effect of early school eligibility (ESE) on school disciplinary absences (SDAs) in secondary school. All estimates are obtained from OLS regression specifications. All specifications include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Individual Characteristics variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Primary School Characteristics variables included are calculated in the final year of primary school and they are the School Deprivation Index, the School ICSEA Index, the share of male classmates, the share of English native speaker classmates, the number of classmates and a series of binary indicators for whether the Primary School Deprivation Index is unknown, for whether the Primary School ICSEA Index is unknown, for whether the share of male classmates in the final year of primary school is unknown, for whether the share of English native speaker classmates in the final year of primary school is unknown, and for whether the number of classmates in the final year of primary school is unknown. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 5. Estimates of School Leaving Age Reform Impact on School Leaving Grade, Crime and SDAs.

	School Leaving Grade	Crime Committed at age 15 to 17	SDA Received at age 15 to 17	Crime Count at age 15 to 17	SDA Count at age 15 to 17	Crime Count at age 15 to 17 + SDA Count at age 15 to 17	
		(Extensive Margin)		(Extensive and Intensive Margin)		(Extensive Margin)	(Extensive and Intensive Margin)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS
EL Reform	0.509***	-0.009***	0.018*	-0.030***	0.031*	0.007	0.001
	(p = 0.003)	(p = 0.008)	(p = 0.095)	(p = 0.007)	(p = 0.059)	(p = 0.511)	(p = 0.929)
Pre EL Reform Mean Dep. Var.	11.414	0.042	0.058	0.114	0.081	0.091	0.195
No. Youths (Full Sample)	293562	293562	293562	293562	293562	293562	293562
EL Reform	0.503***	-0.006**	0.018	-0.021	0.031*	0.009	0.010
	(p = 0.004)	(p = 0.047)	(p = 0.114)	(p = 0.101)	(p = 0.085)	(p = 0.394)	(p = 0.622)
Pre EL Reform Mean Dep. Var.	11.390	0.040	0.059	0.108	0.084	0.091	0.192
No. Youths (60 days Bandwidth)	93924	93924	93924	93924	93924	93924	93924
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table 5 shows estimates of the causal effect of the Earning or Learning (EL) reform on school leaving grade, crime at age 15 to 17 and school disciplinary absences (SDAs) at age 15 to 17. All estimates are obtained from OLS regression specifications. Standard errors were clustered at the year of birth level and the p-values from Wild Cluster Bootstrap estimation are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 6. Estimates of School Leaving Age Reform Impact on School Leaving Grade, Property Crime and Property SDAs.

	School Leaving Grade	Property Crime Committed	Property SDA Received	Property Crime Count	Property SDA Count	Property Crime Count + Property SDA Count	
		(Extensive Margin)		(Extensive and Intensive Margin)		(Extensive Margin)	(Extensive and Intensive Margin)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS
EL Reform	0.509***	-0.005***	0.003*	-0.018***	0.003*	-0.003	-0.015**
	(p = 0.003)	(p = 0.008)	(p = 0.072)	(p = 0.008)	(p = 0.073)	(p = 0.159)	(p = 0.019)
Pre EL Reform Mean Dep. Var.	11.414	0.028	0.005	0.067	0.005	0.032	0.072
No. Youths (Full Sample)	293562	293562	293562	293562	293562	293562	293562
EL Reform	0.503***	-0.004	0.003*	-0.012	0.003*	-0.001	-0.009
	(p = 0.004)	(p = 0.144)	(p = 0.073)	(p = 0.174)	(p = 0.054)	(p = 0.529)	(p = 0.283)
Pre EL Reform Mean Dep. Var.	11.390	0.027	0.005	0.063	0.005	0.031	0.068
No. Youths (60 days Bandwidth)	93924	93924	93924	93924	93924	93924	93924
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table 6 shows estimates of the causal effect of the Earning or Learning (EL) reform on school leaving grade, property crime at age 15 to 17 and property misconduct school disciplinary absences (SDAs) at age 15 to 17. All estimates are obtained from OLS regression specifications. Standard errors were clustered at the year of birth level and the p-values from Wild Cluster Bootstrap estimation are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft by offender in a year. SDAs include property misconduct SDAs received per youth in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 7. Estimates of School Leaving Age Reform Impact on School Leaving Grade, Drugs Crime and Illicit Substance SDAs.

	School Leaving Grade	Drugs Crime Committed	Illicit Substance SDA Received	Drugs Crime Count	Illicit Substance SDA Count	Drugs Crime Count + Illicit Substance SDA Count	
		(Extensive Margin)		(Extensive and Intensive Margin)		(Extensive Margin)	(Extensive and Intensive Margin)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS
EL Reform	0.509***	-0.005***	-0.000	-0.008***	-0.000	-0.005***	-0.008***
	(p = 0.003)	(p = 0.009)	(p = 0.449)	(p = 0.008)	(p = 0.492)	(p = 0.009)	(p = 0.008)
Pre EL Reform Mean Dep. Var.	11.414	0.011	0.002	0.018	0.002	0.013	0.020
No. Youths (Full Sample)	293562	293562	293562	293562	293562	293562	293562
EL Reform	0.503***	-0.004***	-0.000	-0.007***	-0.000	-0.005***	-0.008***
	(p = 0.004)	(p = 0.007)	(p = 0.239)	(p = 0.008)	(p = 0.275)	(p = 0.008)	(p = 0.007)
Pre EL Reform Mean Dep. Var.	11.390	0.010	0.002	0.018	0.002	0.012	0.020
No. Youths (60 days Bandwidth)	93924	93924	93924	93924	93924	93924	93924
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7 shows estimates of the causal effect of the Earning or Learning (EL) reform on school leaving grade, drugs crime at age 15 to 17 and illicit substances school disciplinary absences (SDAs) at age 15 to 17. All estimates are obtained from OLS regression specifications. Standard errors were clustered at the year of birth level and the p-values from Wild Cluster Bootstrap estimation are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include drugs crimes by offender in a year. SDAs include illicit substances SDAs received per youth in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table 8. Estimates of School Leaving Age Reform Impact on School Leaving Grade, Violence Crime and Violence SDAs.

	School Leaving Grade	Violence Crime Committed	Violence SDA Received	Violence Crime Count	Violence SDA Count	Violence Crime Count + Violence SDA Count	
		(Extensive Margin)		(Extensive and Intensive Margin)		(Extensive Margin)	(Extensive and Intensive Margin)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS
EL Reform	0.509***	-0.000	0.007*	-0.000	0.008**	0.006	0.008*
	(p = 0.003)	(p = 0.215)	(p = 0.054)	(p = 0.482)	(p = 0.040)	(p = 0.129)	(p = 0.059)
Pre EL Reform Mean Dep. Var.	11.414	0.008	0.017	0.010	0.018	0.024	0.029
No. Youths (Full Sample)	293562	293562	293562	293562	293562	293562	293562
EL Reform	0.503***	0.000	0.007*	0.001	0.008**	0.006	0.008**
	(p = 0.004)	(p = 0.923)	(p = 0.055)	(p = 0.145)	(p = 0.045)	(p = 0.102)	(p = 0.034)
Pre EL Reform Mean Dep. Var.	11.390	0.008	0.017	0.010	0.019	0.024	0.029
No. Youths (60 days Bandwidth)	93924	93924	93924	93924	93924	93924	93924
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8 shows estimates of the causal effect of the Earning or Learning (EL) reform on school leaving grade, violence crime at age 15 to 17 and violence school disciplinary absences (SDAs) at age 15 to 17. All estimates are obtained from OLS regression specifications. Standard errors were clustered at the year of birth level and the p-values from Wild Cluster Bootstrap estimation are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. SDAs include physical misconduct SDAs received per youth in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

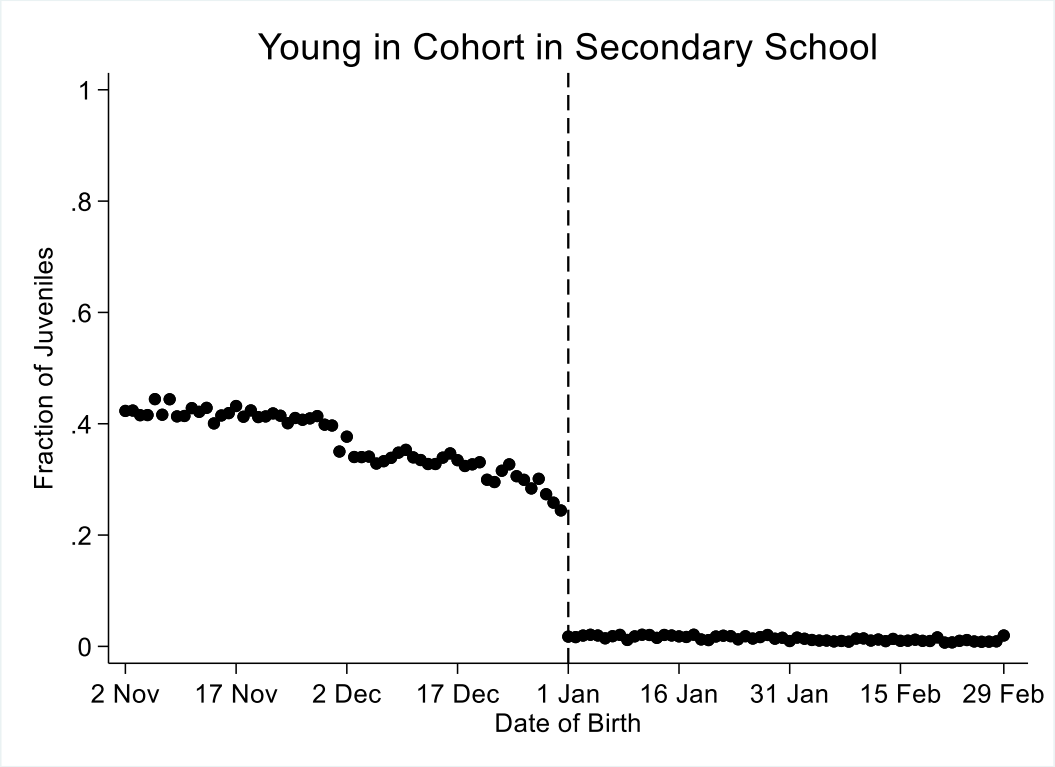
Table 9. Estimates of SDA by Age 17 Impact on Crime at Age 18 to 24.

	Crime Committed Age 18 to 24 (Extensive Margin)			Crime Committed Age 18 to 24 (Extensive and Intensive Margin)		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
Count of SDAs from Age 15 to 17	0.063***	0.000	-0.000	0.158***	-0.035***	-0.044***
	(0.001)	(0.001)	(0.001)	(0.008)	(0.011)	(0.011)
Mean Dependent Variable	0.038	0.038	0.038	0.097	0.097	0.097
No. Observations (Full Sample)	1574442	1574442	1574442	1574442	1574442	1574442
No. Youths (Full Sample)	524814	524814	524814	524814	524814	524814
Count of SDAs from Age 15 to 17	0.064***	0.002	0.002	0.153***	-0.014	-0.025**
	(0.002)	(0.002)	(0.002)	(0.011)	(0.012)	(0.012)
Mean Dependent Variable	0.038	0.038	0.038	0.095	0.095	0.095
No. Observations (60 days Bandwidth)	504015	504015	504015	504015	504015	504015
No. Youths (60 days Bandwidth)	168005	168005	168005	168005	168005	168005
Individual Characteristics	Yes	No	No	Yes	No	No
Year of Birth Fixed Effects	Yes	No	No	Yes	No	No
Crime Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	No	Yes	Yes	No	Yes	Yes
Count of Crimes from Age 15 to 17	No	No	Yes	No	No	Yes

Notes: Table 9 shows estimates of the causal effect of the count of SDAs received at age 15 to 17 on crime committed at age 18 to 24. All estimates are obtained from OLS regression specifications. Robust standard errors (clustered at the individual level) are reported in parentheses. Individual Characteristics variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs and violence by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs and physical misconduct SDAs received per youth in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

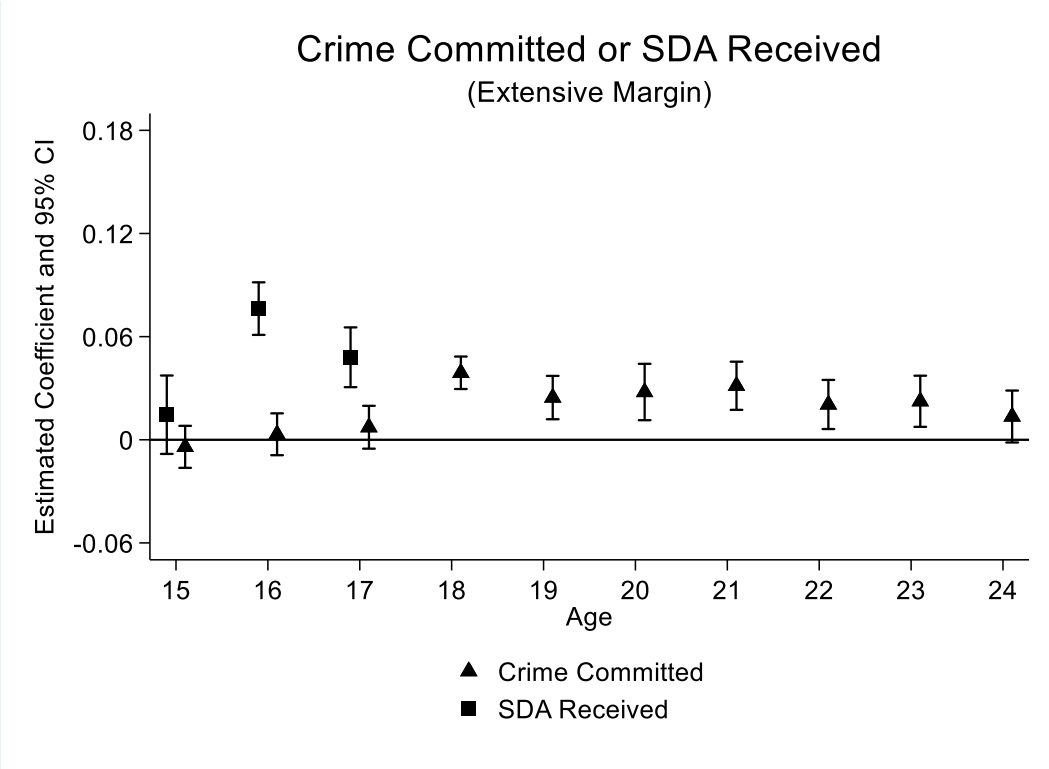
APPENDIX

Figure A.1. Fraction of Young in Cohort (YINC) Juveniles in Secondary School by Date of Birth.



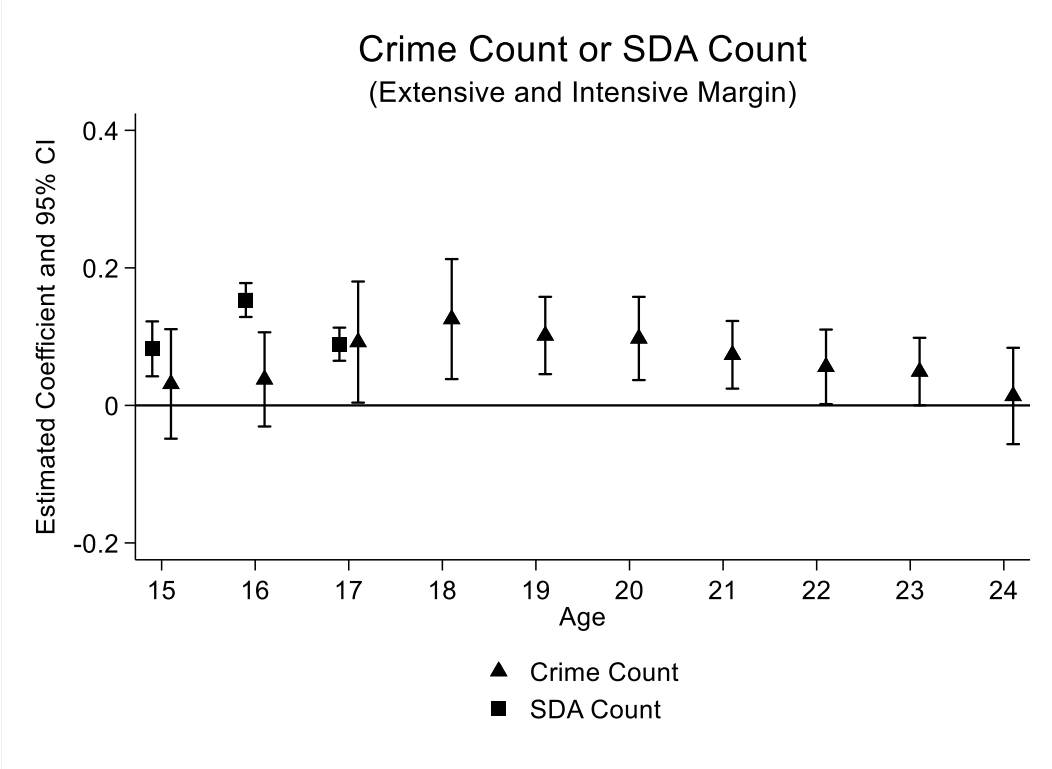
Notes: Figure A.1 shows the fraction of juveniles who are 'young-in-cohort' at age 15 by date of birth for juveniles born 60 days either side of the 1st January cut-off.

Figure A.2. IV Estimates of YINC in Secondary School Impact on Crime and SDAs by Age at the Extensive Margin.



Notes: Figure A.2 shows point estimates and 95 percent confidence intervals of the causal effect of being young in cohort in secondary school on the likelihood to commit crime (extensive margin) and on the likelihood to receive school disciplinary absences (SDAs, extensive margin) by age. All estimates are obtained from IV regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1), their interaction term and discontinuity fixed effects. Robust standard errors were clustered at the date of birth level. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Figure A.3. IV Estimates of YINC in Secondary School Impact on Crime and SDAs by Age at the Extensive and Intensive Margin.



Notes: Figure A.3 shows point estimates and 95 percent confidence intervals of the causal effect of being young in cohort in secondary school on the count of crime offences (extensive and intensive margin) and on the count of school disciplinary absences (SDAs, extensive and intensive margin) by age. All estimates are obtained from IV regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1), their interaction term and discontinuity fixed effects. Robust standard errors were clustered at the date of birth level. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Table A.1. Means of Selected Crime Outcomes by Types of Crime.

	Crime Committed (Extensive Margin)					Crime Count (Extensive and Intensive Margin)					
Age:	All Crimes	Property Crime	Drugs	Violence	Other Crimes	All Crimes	Property Crime	Drugs	Violence	Other Crimes	No. Youths
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15	0.032	0.023	0.006	0.007	0.007	0.096	0.059	0.009	0.010	0.019	203355
16	0.034	0.023	0.008	0.008	0.007	0.101	0.059	0.013	0.011	0.019	202979
17	0.036	0.021	0.012	0.008	0.007	0.098	0.052	0.020	0.011	0.015	185578
18	0.036	0.019	0.015	0.008	0.006	0.094	0.046	0.026	0.010	0.012	168005
19	0.033	0.015	0.015	0.007	0.004	0.079	0.034	0.027	0.009	0.009	149832
20	0.029	0.013	0.015	0.006	0.003	0.065	0.026	0.025	0.008	0.006	131342
21	0.026	0.011	0.014	0.006	0.003	0.056	0.021	0.024	0.007	0.005	112424
22	0.023	0.010	0.012	0.005	0.002	0.052	0.019	0.022	0.006	0.004	93816
23	0.021	0.009	0.011	0.005	0.002	0.047	0.016	0.020	0.006	0.004	75148
24	0.020	0.008	0.011	0.005	0.002	0.045	0.015	0.021	0.006	0.003	57330
Overall	0.031	0.017	0.011	0.007	0.005	0.081	0.041	0.020	0.009	0.012	203355

Notes: Table A.1 shows means of selected crime outcomes by types of crime. All crimes includes property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year.

Table A.2. Means of Selected SDA Outcomes by Types of SDA.

	SDA Received (Extensive Margin)					SDA Count (Extensive and Intensive Margin)					
Age:	All SDAs	Property Misconduct	Illicit Substance	Physical Misconduct	Other SDAs	All SDAs	Property Misconduct	Illicit Substance	Physical Misconduct	Other SDAs	No. Youths
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15	0.091	0.011	0.003	0.032	0.066	0.153	0.011	0.003	0.036	0.103	203355
16	0.069	0.007	0.002	0.020	0.052	0.103	0.007	0.002	0.022	0.071	202979
17	0.043	0.004	0.001	0.009	0.033	0.057	0.004	0.001	0.010	0.042	185578
Overall	0.069	0.007	0.002	0.021	0.051	0.105	0.008	0.002	0.023	0.073	203355

Notes: Table A.2 shows means of selected school disciplinary absence (SDA) outcomes by types of SDA. All SDAs includes property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs.

Table A.3. First Stage Estimates of ESE Impact on Young in Cohort (YINC) in Secondary School.

	YINC	YINC	YINC	YINC
	(1)	(2)	(3)	(4)
	OLS		Local Polynomial	
ESE (Nov-Dec = 1)	0.260***	0.259***	0.262***	0.261***
	(0.005)	(0.005)	(0.006)	(0.006)
No. Youths	203355	203355	203355	203355
Primary School Characteristics	No	Yes	No	Yes
Individual Characteristics	Yes	Yes	Yes	Yes
Discontinuity Fixed Effects	Yes	Yes	Yes	Yes

Notes: Estimates in columns (1) and (2) are obtained from OLS regression specifications. Estimates in columns (3) and (4) are obtained from local linear regression specifications where a triangular kernel with bandwidth of 60 days is used. All specifications include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Regressions in columns (1) and (3) also include controls for whether the juvenile is male, whether s/he is a native speaker and whether the native language is unknown. Regressions in columns (2) and (4) also include Primary School Characteristics variables calculated in the final year of primary school. Primary School Characteristics variables included are the School Deprivation Index, the School ICSEA Index, the share of male classmates, the share of English native speaker classmates, the number of classmates and binary indicators for whether the Primary School Deprivation Index is unknown, for whether the Primary School ICSEA Index is unknown, for whether the share of male classmates in the final year of primary school is unknown, for whether the share of English native speaker classmates in the final year of primary school is unknown, and for whether the number of classmates in the final year of primary school is unknown. Robust standard errors are clustered at the date of birth level. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table A.4. IV Estimates of YINC in Secondary School Impact on Crime.

	Crime Committed (Extensive Margin)			Crime Count (Extensive and Intensive Margin)		
	(1)	(2)	(3)	(4)	(5)	(6)
	IV	IV	IV	IV	IV	IV
YINC	0.013***	0.021***	0.020***	0.052***	0.076***	0.070***
	(0.003)	(0.003)	(0.003)	(0.015)	(0.015)	(0.014)
No. Youths (90 days Bandwidth)	308628	308628	308628	308628	308628	308628
YINC	0.013***	0.021***	0.018***	0.063***	0.084***	0.073***
	(0.004)	(0.003)	(0.003)	(0.020)	(0.019)	(0.018)
No. Youths (60 days Bandwidth)	203355	203355	203355	203355	203355	203355
YINC	0.014***	0.019***	0.017***	0.062***	0.077***	0.063***
	(0.005)	(0.004)	(0.003)	(0.024)	(0.024)	(0.018)
No. Youths (30 days Bandwidth)	101285	101285	101285	101285	101285	101285
Primary School Characteristics	No	Yes	Yes	No	Yes	Yes
Primary School x Discontinuity Fixed Effects	No	No	Yes	No	No	Yes
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Discontinuity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table A.4 shows estimates of the causal effect of being young in cohort in secondary school on crime. All estimates are obtained from IV regression specifications. All specifications include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Individual Characteristics variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Primary School Characteristics variables included are calculated in the final year of primary school and they are the School Deprivation Index, the School ICSEA Index, the share of male classmates, the share of English native speaker classmates, the number of classmates and a series of binary indicators for whether the Primary School Deprivation Index is unknown, for whether the Primary School ICSEA Index is unknown, for whether the share of male classmates in the final year of primary school is unknown, for whether the share of English native speaker classmates in the final year of primary school is unknown, and for whether the number of classmates in the final year of primary school is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table A.5. IV Estimates of YINC in Secondary School Impact on SDAs.

	SDA Received (Extensive Margin)			SDA Count (Extensive and Intensive Margin)		
	(1)	(2)	(3)	(4)	(5)	(6)
	IV	IV	IV	IV	IV	IV
YINC	0.043***	0.044***	0.043***	0.104***	0.105***	0.104***
	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)
No. Youths (90 days Bandwidth)	308628	308628	308628	308628	308628	308628
YINC	0.042***	0.043***	0.043***	0.100***	0.101***	0.101***
	(0.007)	(0.007)	(0.006)	(0.011)	(0.011)	(0.011)
No. Youths (60 days Bandwidth)	203355	203355	203355	203355	203355	203355
YINC	0.031***	0.031***	0.028***	0.075***	0.076***	0.072***
	(0.010)	(0.010)	(0.009)	(0.016)	(0.017)	(0.018)
No. Youths (30 days Bandwidth)	101285	101285	101285	101285	101285	101285
Primary School Characteristics	No	Yes	Yes	No	Yes	Yes
Primary School x Discontinuity Fixed Effects	No	No	Yes	No	No	Yes
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Discontinuity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table A.5 shows estimates of the causal effect of being young in cohort in secondary school on school disciplinary absences (SDAs). All estimates are obtained from IV regression specifications. All specifications include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Individual Characteristics variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Primary School Characteristics variables included are calculated in the final year of primary school and they are the School Deprivation Index, the School ICSEA Index, the share of male classmates, the share of English native speaker classmates, the number of classmates and a series of binary indicators for whether the Primary School Deprivation Index is unknown, for whether the Primary School ICSEA Index is unknown, for whether the share of male classmates in the final year of primary school is unknown, for whether the share of English native speaker classmates in the final year of primary school is unknown, and for whether the number of classmates in the final year of primary school is unknown. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table A.6. Local Polynomial Estimates of ESE Impact and YINC Impact on Crime and SDAs.

		Crime Committed (Extensive Margin)	Crime Count (Extensive and Intensive Margin)	SDA Received (Extensive Margin)	SDA Count (Extensive and Intensive Margin)
		(1)	(2)	(3)	(4)
(1)	ESE	0.002**	0.013**	0.011***	0.026***
		(0.001)	(0.005)	(0.002)	(0.003)
(2)	YINC	0.010**	0.051**	0.045***	0.104***
		(0.004)	(0.020)	(0.009)	(0.014)
	Mean Dependent Variable	0.031	0.081	0.069	0.105
	No. Youths (60 days Bandwidth)	203355	203355	203355	203355
	Primary School Characteristics	No	No	No	No
	Primary School x Discontinuity Fixed Effects	No	No	No	No
	Individual Characteristics	Yes	Yes	Yes	Yes
	Age Fixed Effects	Yes	Yes	Yes	Yes
	Discontinuity Fixed Effects	Yes	Yes	Yes	Yes

Notes: Row (1) of Table A.6 shows estimates of the causal effect of early school eligibility (ESE) on crime and school disciplinary absences (SDAs) in secondary school. Estimates in Row (1) are obtained from sharp local linear regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Row (2) of Table A.6 shows estimates of the causal effect of being young in cohort on crime and SDAs in secondary school. Estimates in Row (2) are obtained from fuzzy local linear regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. A triangular kernel is used in all cases. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.

Table A.7. Robustness Estimates of ESE Impact and YINC Impact on Crime and SDAs.

		Crime Committed (Extensive Margin)	Crime Count (Extensive and Intensive Margin)	SDA Received (Extensive Margin)	SDA Count (Extensive and Intensive Margin)
		(1)	(2)	(3)	(4)
(1)	ESE	0.003**	0.015**	0.005**	0.012***
		(0.002)	(0.007)	(0.002)	(0.004)
(2)	YINC	0.011**	0.052**	0.016**	0.042***
		(0.005)	(0.026)	(0.008)	(0.015)
	Mean Dependent Variable	0.033	0.081	0.060	0.086
	No. Youths (60 days Bandwidth)	57330	57330	57330	57330
	Primary School Characteristics	No	No	No	No
	Primary School x Discontinuity Fixed Effects	No	No	No	No
	Individual Characteristics	Yes	Yes	Yes	Yes
	Age Fixed Effects	Yes	Yes	Yes	Yes
	Discontinuity Fixed Effects	Yes	Yes	Yes	Yes

Notes: Row (1) of Table A.7 shows estimates of the causal effect of early school eligibility (ESE) on crime and school disciplinary absences (SDAs) in secondary school. Estimates in Row (1) are obtained from OLS regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Row (2) of Table A.7 shows estimates of the causal effect of being young in cohort on crime and SDAs in secondary school. Estimates in Row (2) are obtained from IV regression specifications, which include distance to the 1st January cut-off, pre-cut-off indicator (Nov-Dec = 1) and their interaction term. Robust standard errors (clustered at the date of birth level) are reported in parentheses. Control variables included are dummies for whether the youths are male, whether they are native English speakers and whether the native language is unknown. Crime offences include property damage and theft, drugs, violence and other crimes by offender in a year. Violence crime include violence against the person, sexual offences, and public order offences by offender in a year. Other crimes includes burglary, dangerous or negligent acts endangering persons, blackmail, fraud, deception and related offences, robbery, weapon offences, traffic and vehicle regulatory offences, offences against justice procedures, government security and government operations offences, and miscellaneous offences by offender in a year. SDAs include property misconduct SDAs, illicit substance SDAs, physical misconduct SDAs and other SDAs received per youth in a year. Other SDAs includes absence SDAs, licit substance SDAs, persistently disruptive behaviour SDAs, refusal to participate SDAs, verbal SDAs and other misconduct SDAs. * indicates significance at 10 percent, ** indicates significance at 5 percent, *** indicates significance at 1 percent.