The effect of delayed school entry on crime

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Preliminary results

Introduction

- More than three decades of empirical research has shown education to have a desirable effect on just about every outcome of interest in the social sciences.
- For example, higher levels of education have been shown to increase:
  - lifetime earnings (Angrist & Krueger, 1991);
  - civic engagement (Dee, 2004);
  - cognitive skills in old age (Banks & Mazzonna, 2012); and
  - longevity (Lleras-Muney, 2005).
- In terms of research looking at the effect of education on crime, two popular areas include:
  1. The effect of delayed school entry on crime (entry laws).
  2. The effect of raising the minimum school leaving age on crime (exit laws).
- The broader paper I'm working on involves examining both effects.
- Today, we're just going to be focusing on the Delayed School Entry (DSE) effect.

Idea behind the Delayed School Entry (DSE) effect

- Within a given grade cohort, school entry laws generally result in some share of students being older than others.
- For example, in NSW students turn:
  - five or six in the year that they enter kindergarten;
  - 14 or 15 in grade 9; and
  - 17 or 18 in grade 12.
- So if there is a one-year age gap between some students in the same grade, it raises the question of whether older students:
  - will do better academically (e.g., because they're more mature)
    - which we know is true, at least in the short-term (Bedard & Dhuey, 2006; McEwan & Shapiro, 2008)
  - will be less prone to crime (e.g., because they have higher levels of human capital)
    - which we know to be true, at least during the years that a student is in school (Cook & Kang, 2016; Depew & Eren, 2016; Landersø et. al., 2017)

Today's presentation

- Today, we're going to see whether this is true for students educated in the early 2010s in NSW.
- That is our two research questions are:
  1. Are kids with DSE less likely to commit crime?
  2. If so, why?
- The remainder of this presentation is structured as follows:
  1. How school entry laws work in NSW
  2. Data sources
  3. Empirical approach
  4. Results
  5. Summary
- Note: there will be plenty of recaps throughout, so don't worry if you miss something, let lost or zone out for a minute.

School entry laws in NSW I/II

- In NSW, a student can enter their first year of school (i.e., kindergarten) in the calendar year that they turn five (no-DSE) or six (DSE).
- Whether a student enters in the year that they turn five or six depends on their month-of-birth.
- The parents of children born between:
  - January and July get to *choose* whether their children enter kindergarten in the year that they turn five or six (so a mix of no-DSE and DSE).
  - August and December are required to have their children enter kindergarten in the year that they turn six (DSE).
- Following kindergarten, students progress through grades 1 – 12 sequentially.
- Let's consolidate this into a table.

School entry laws in NSW II/II

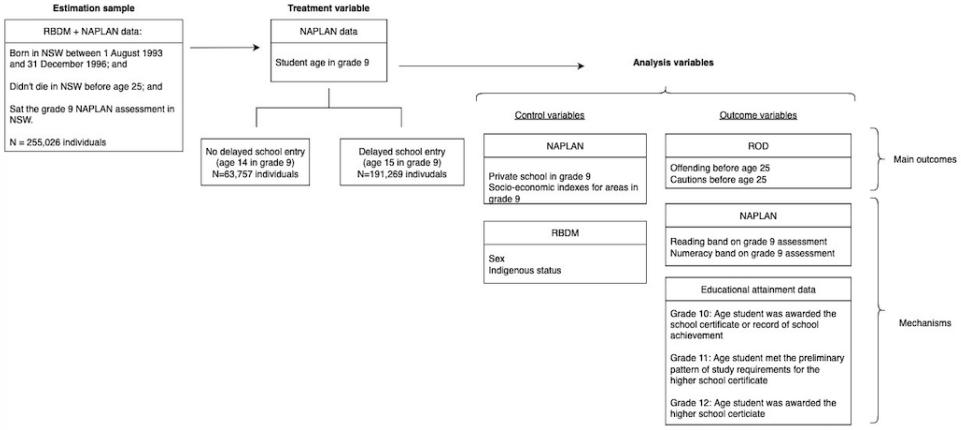
Cohort beginning	Cohort end	Delayed school entry	School entry (kindergarten)	NAPLAN (grade 9)
1-Aug-1993	31-Dec-1993	Yes	1999 (age 6)	2008 (age 15)
1-Jan-1994	31-Jul-1994	Mix	1999 (age 5) or 2000 (age 6)	2008 (age 14) or 2009 (age 15)
1-Aug-1994	31-Dec-1994	Yes	2000 (age 6)	2009 (age 15)
1-Jan-1995	31-Jul-1995	Mix	2000 (age 5) or 2001 (age 6)	2009 (age 14) or 2010 (age 15)
1-Aug-1995	31-Dec-1995	Yes	2001 (age 6)	2010 (age 15)
1-Jan-1996	31-Jul-1996	Mix	2001 (age 5) or 2002 (age 6)	2010 (age 14) or 2011 (age 15)
1-Aug-1996	31-Dec-1996	Yes	2002 (age 6)	2011 (age 15)

Why these dates? Well, our estimation sample consists of people born in NSW between 1 August 1993 - 31 December 1996.

Recap

- In NSW, students commence school in the year that they turn five (no-DSE) or six (DSE).
  - Note: whether they have DSE (partly) depends on their month-of-birth.
- As a result, there is always a relative age difference between students in the same grade.
- We want to understand whether this relative age difference has an impact on crime (i.e., whether older students are less likely to commit crime).
- We might expect older students to commit less crime because they're more mature (e.g., which leads to higher levels of human capital, so higher opportunity cost of crime).
- Now let's talk data.

Data



Now let's talk about how we should use these data.

How should we identify the DSE effect?

Okay, so why not just compare crime outcomes between DSE and no-DSE kids?

1. Well, one reason is that it has been known for some time that DSE results in better academic performance.
   - So parents that (can afford to) choose to delay their child's entry into school might provide better learning environments, have more financial resources etc.
   - As such, a simple comparison might cause us to **overestimate** the benefit of DSE (e.g., because we're comparing high SES vs. low SES kids).
2. Another reason is that boys tend to be less mature than girls.
   - So perhaps boys are more likely to have DSE than girls.
   - Boys are also more likely to commit crime.
   - As such, a simple comparison might cause us to **underestimate** the benefit of DSE (e.g., because we're comparing boys with girls).

Let's see if these theories are supported by the data.

Summary statistics

	No delayed school entry (1)	Delayed school entry (2)	Difference (3)
Panel A. Crime before age 25			
Any crime	0.157	0.161	0.005***
Violent crime	0.050	0.051	0.002
Property crime	0.035	0.038	0.003***
Drug crime	0.037	0.038	0.001
Panel B. Grade 9 NAPLAN band			
Grade 9 reading band	7.532	7.565	0.033***
Grade 9 numeracy band	7.719	7.650	-0.069***
Panel C. Educational attainment			
Grade 10	0.952	0.937	-0.015***
Grade 11	0.826	0.777	-0.049***
Grade 12	0.752	0.696	-0.057***
Panel D. Controls			
Male	0.448	0.534	0.086***
Aboriginal	0.025	0.019	-0.005***
SEIFA (grade 9 address)	5.440	5.671	0.232***
Private school in grade 9	0.364	0.389	0.025***

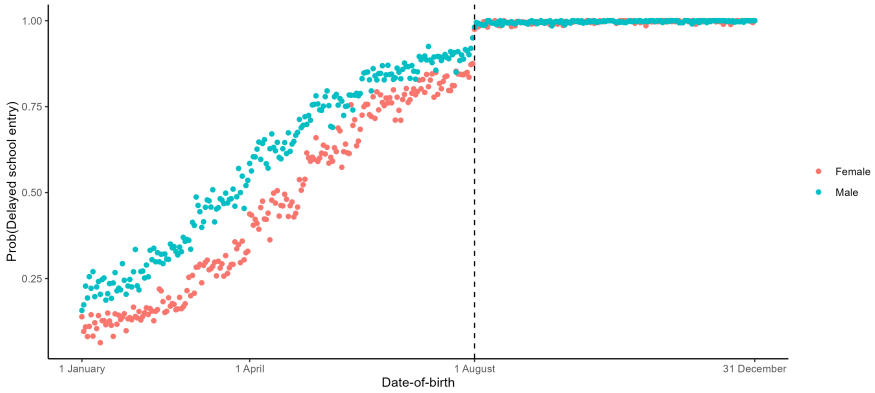
*Note. p<0.01 ***; p<0.05 **; p<0.1 *.*

So there probably is a selection bias problem, what can we do about it?

Use variation in month-of-birth to identify the DSE effect I/II

- What we need is variation in the probability of DSE that is (otherwise) unrelated to crime.
- Let's consider whether a child's month-of-birth can provide such variation:
  - when compared with the parents of children born in July,
  - the parents of children born in January,
  - face an additional six months of childcare costs and/or forgone earnings should they choose to delay their child's entry into kindergarten.
- In other words: the earlier in the year that a child is born, the more money parents are looking at in terms of childcare costs if they choose DSE, so the less likely they are to delay their child's entry into school.
- Let's see whether that theory is supported by the data.

Use variation in month of birth? II/II

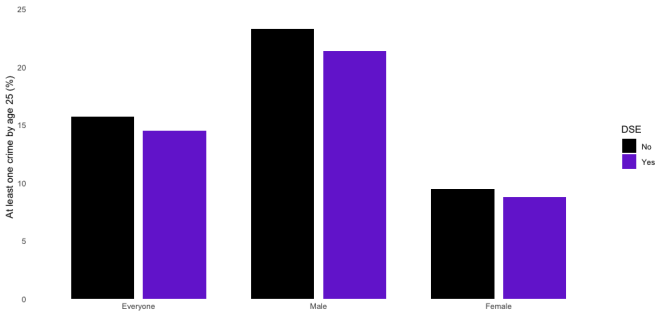


Nice, a student's month-of-birth is related to their DSE status, but why is that helpful?

Instrumental Variables (IV)

- IV allows us to identify the DSE effect of by exploiting variation in the probability of DSE that 'as good as random' (i.e., unrelated to SES and sex).
- This is done using a third variable called an 'instrument'.
- The instrument we're going to consider is a student's month-of-birth.
- The idea is this:
  1. if an individual's month-of-birth impacts whether they have DSE; and
  2. has no other impact on their offending behaviour; then
  3. it enables us to isolate our comparison to (the subset of) students whose DSE status is influenced by their month-of-birth.
- In other words, IV limits our comparison to kids with vs. without DSE because of their month-of-birth (and nothing systematic, like SES or sex).
- Pictures are usually helpful here...

Results: relative age effect on crime

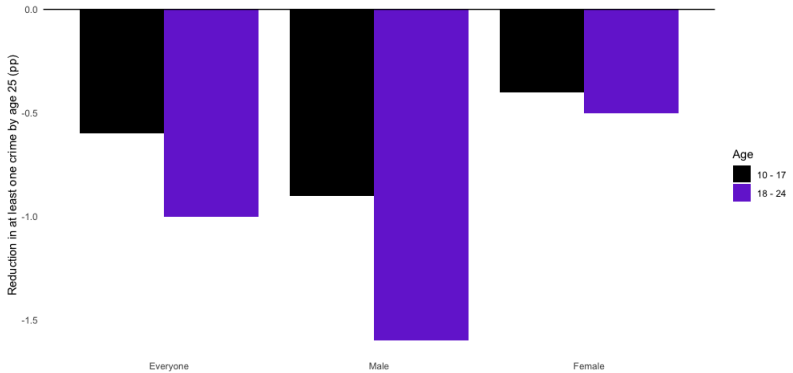


- 1.2pp reduction for everyone: 15.7% $\rightarrow$ 14.5%.
- 1.9pp reduction for males: 23.3% $\rightarrow$ 24.1%.
- 0.7pp reduction for females: 9.5% $\rightarrow$ 8.8%.

Recap

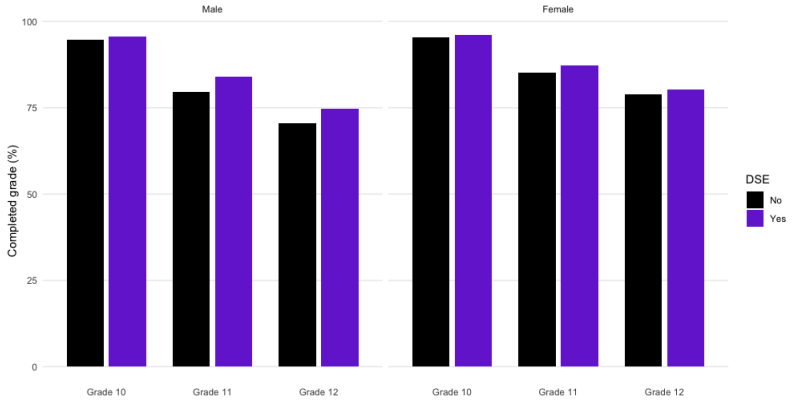
- Okay, so far we can see that DSE reduces crime.
- So, the next question to ask is *how* this reduction in crime is coming about?
- Two explanations include:
  1. Incapacitation
     - That is, the reduction in crime that comes about because kids are in school instead of on the street.
     - To look at incapacitation, we can examine the share of the total reduction in crime that occurs during the ages that a student is in school.
  2. Different preferences or increases in human capital
     - That is, the reduction in crime that comes about because students are more engaged in school and have higher levels of human capital as a result.
     - To look at this explanation, we can examine the effect of DSE on test scores and educational attainment.
- Now let's take a look at these mechanisms.

Incapacitation: the relative age effect on crime by age



Some of the reduction occurs between the ages a student is at school, but most of the reduction occurs in the years after a student leaves school.

Human capital: the relative age effect on educational attainment



DSE kids more likely to finish school, so they have higher levels of human capital.

Final recap, take home messages

1. Results:
   - DSE lowers the probability of a conviction by age 25.
   - The effect is stronger for boys than girls.
   - A good chuck of the reduction occurs during both a student's time in school (ages 10 - 17) and after they leave school (ages 18 - 24).
   - DSE also see improves in test scores and educational attainment.
2. Implications for parents:
   - if you have a boy, its a good idea to delay his entry into school if you can;
   - if you have a girl, it matters less from a crime reduction standpoint, but probably still a good idea.
3. Implication for policymakers:
   - from both a crime reduction and education standpoint, having all students enrol in school in the year that they turn six might be a good idea.
   - In fact, the DSE effect is bigger than the effect of raising the minimum school leaving age from 15 to 17!

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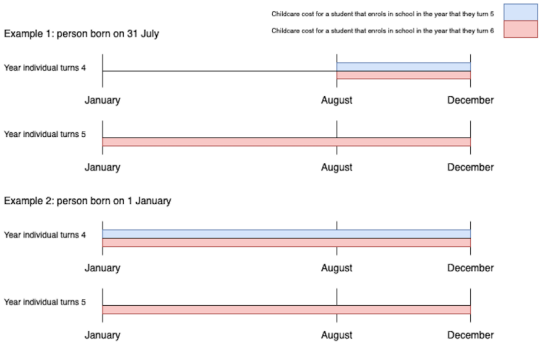
Data sources

1. Data on births and deaths from the NSW Registry of Births, Deaths and Marriages (RBDM), which contains a list of people:
   - born in NSW between 1992 and 1996; and
   - that died in NSW before 1 April 2024.
2. National Assessment Plan – Literacy and Numeracy (NAPLAN) data from the NSW Education Standards Authority (NESA)
   - Contains information for people in the RBDM data that sat the grade 9 NAPLAN assessment.
3. Educational attainment data from NESA.
   - Contains information for people in the RBDM data that were enrolled in a grade 10, 11 or 12 course in a NSW secondary school.
4. Crime data from the NSW Bureau of Crime Statistics and Research (BOCSAR).
   - Contains information for people in the RBDM data charged with an offence by NSW Police before 1 January 2024.

Assumptions required for Instrumental Variables (IV)

1. **Relevance:** An individual's month-of-birth must influence whether they are old for their grade cohort.
   - This can be empirically tested, and holds in our case.
2. **Monotonicity:** Individuals both later in the year must be (weakly) be more likely to be old for their grade cohort.
   - This cannot be empirically tested.
   - Available evidence indicates that it likely holds.
3. **Exclusion restriction:** An individual's month-of-birth can only influence their offending behaviour via whether they are relatively old for their grade cohort.
   - This cannot be empirically tested.
   - We are required to provide an argument as to why it holds.

Supporting use of the instrument



Bottom line:

1. There is always a financial incentive to enrol your kid into school ASAP.
2. The earlier in the year that your kid is born, the stronger the incentive.

Two-Stage Least Squares (2SLS)

$$old_i = \pi_0 + \pi_1 Z_i + \gamma \mathbf{X_i'} + e_i \quad \text{(FS)}$$

$$crime_i = \beta_0 + \beta_1 Z_i + \theta \mathbf{X_i'} + v_i \quad \text{(RF)}$$

- old_i denotes a binary variable equal to one if individual i is old for their grade cohort, zero otherwise.
- Z_i denotes the number of days between an individual's date-of-birth and 1 August, within each calendar year.
- $\mathbf{X_i'}$ denotes a set of control variables and cohort fixed effects.
- e_i and v_i denote error terms, and all other terms are coefficients to be estimated.
- The ratio $\frac{\beta_1}{\pi_1}$ gives us the DSE effect, among the sub-population of individuals whose month-of-birth influences their kindergarten entry age.
  - Note: our estimates say nothing about parents who would always delay their kid's entry into school (e.g., parents that can comfortably afford childcare).

Who are the compliers?

- The ratio $\frac{\beta_1}{\pi_1}$ provides us with a consistent estimate of the DSE effect on crime for the sub-population of individuals whose school entry age is influenced by their month-of-birth.
- In the IV literature, these people are referred to as 'compliers'.
- In our context, compliers refer to children whose parents get them into school ASAP.
- That is:
  - non-DSE students born *before* August that would have had DSE had they been born after August (because their parents would have had no choice); and
  - DSE students born *after* August that would have had non-DSE had they been born before August (because their parents would prefer to have sent them in earlier).
- Intuitively, we would expect the compliers to come from non-high SES families sensitive to childcare costs.

Treatment effects

In addition to the compliers, we also have:

- Some non-zero proportion of always-takers.
  - That is, children whose parents would ensure that they were relatively old, regardless.
- Zero never-takers.
  - That is, children whose parents would ensure that they were never old.
  - Since the parents of children born after August have no choice, there are no never-takers.
- Zero defiers.
  - That is, children whose parents do the opposite of the compliers.
  - By virtue of monotonicity, we don't need to worry about the defiers.
- Note: since there are no never-takers, we have $LATE \approx ATU$.
  - Intuitively, since there are no children whose parents ensure that they are never old, these children are lumped in with the compliers.
  - This is analogous to settings with no always-takers, where $LATE \approx ATT$.

Results: relative age effect on crime

Outcome: At least one proven offence (of various types) by age 25.

	Any crime	Violent crime	Property crime	Drug crime
	(1)	(2)	(3)	(4)
Panel A. Everyone	-0.012***	-0.004**	-0.004**	-0.002
N=247,196	(0.003)	(0.002)	(0.001)	(0.001)
	[0.157]	[0.050]	[0.035]	[0.037]
Panel B. Male	-0.019***	-0.009***	-0.006**	-0.003
n=126,708	(0.005)	(0.003)	(0.003)	(0.003)
	[0.233]	[0.081]	[0.059]	[0.065]
Panel C. Female	-0.007**	0.000	-0.001	-0.001
n=120,488	(0.003)	(0.002)	(0.001)	(0.001)
	[0.095]	[0.024]	[0.016]	[0.015]

*Note. p<0.01 ***, p<0.05 **, p<0.1 *, standard errors in round parentheses, control group mean in square parentheses.*

- 15.7% of people without DSE have at least one proven offence by age 25.
- DSE lowers that probability by 1.2 percentage points (pp).
- So DSE effect: 15.7% $\rightarrow$ 14.5%.

Incapacitation: the relative age effect on crime by age

	Any crime		Violent crime		Property crime		Drug crime		Caution
	10 - 17	18 - 24	10 - 17	18 - 24	10 - 17	18 - 24	10 - 17	18 - 24	10 - 17
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Everyone	-0.006***	-0.010***	-0.000	-0.004**	-0.001	-0.003**	0.001	-0.002	-0.006***
N=247,196	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)
	[0.079]	[0.117]	[0.016]	[0.041]	[0.013]	[0.029]	[0.003]	[0.036]	[0.063]
Panel B. Male	-0.009**	-0.016***	-0.002	-0.008***	-0.001	-0.006**	0.002**	-0.004	-0.007**
n=126,708	(0.004)	(0.005)	(0.002)	(0.003)	(0.002)	(0.003)	(0.001)	(0.003)	(0.003)
	[0.111]	[0.188]	[0.027]	[0.068]	[0.022]	[0.049]	[0.005]	[0.062]	[0.085]
Panel C. Female	-0.004*	-0.005**	0.001	-0.000	-0.000	-0.001	-0.000	-0.001	-0.004**
n=120,488	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)
	[0.052]	[0.059]	[0.008]	[0.019]	[0.006]	[0.012]	[0.001]	[0.014]	[0.045]

*Note. p<0.01 ***, p<0.05 **, p<0.1 *, standard errors in round parentheses, control group mean in square parentheses.*

Human capital: the relative age effect on education

	Grade 9 reading band	Grade 9 numeracy band	Complete grade 10	Complete grade 11	Complete grade 12
	(1)	(2)	(3)	(4)	(5)
Panel A. Everyone	0.119***	0.137***	0.009***	0.033***	0.027***
N=236,201	(0.010)	(0.010)	(0.002)	(0.003)	(0.003)
	[7.532]	[7.719]	[0.952]	[0.826]	[0.752]
Panel B. Male	0.122***	0.154***	0.010***	0.046***	0.040***
n=120,702	(0.016)	(0.017)	(0.003)	(0.005)	(0.006)
	[7.399]	[7.817]	[0.947]	[0.795]	[0.706]
Panel C. Female	0.119***	0.124***	0.007***	0.022***	0.015***
n=115,499	(0.013)	(0.013)	(0.002)	(0.004)	(0.004)
	[7.639]	[7.640]	[0.955]	[0.851]	[0.789]

*Note. p<0.01 ***; p<0.05 **; p<0.1 *; standard errors in round parentheses, control group mean in square parentheses.*