Can Academic Redshirting Shrink the Education Gender Gap? Causal Evidence on Student Achievement and Mental Health

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2025 December 5, NBER Economics of Education Program Meeting

Introduction

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- For example: *Anna*: born *Mar*15, before enrollment cutoff of *Jun*1 in Hungary
  - prescribed $SSA = 6$
- *Anna* complied with school enrollment rule: actual $SSA = 6 \rightarrow$ *not redshirted*
- Yet, 40% of her cohort born in March did not comply: $SSA = 7 \rightarrow$ *redshirted*

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   - Yet, no prior research identified the effect of starting a year older due to *AR* itself

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3. Huge gender disparities at school-start and in educational trajectories
   - Can *AR* effectively shrink the education gender gap and mitigate the *'boys' crisis'*?

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4. new evidence for mechanism: negative selection into *AR* – non-school-readiness
   - driven by boys, whose mental health improves above their student achievement

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4. new evidence for mechanism: negative selection into *AR* – non-school-readiness
   - driven by boys, whose mental health improves above their student achievement
5. comparison of: effect of starting school a year older due to (i) *AR* around *Jan*1 (new) *vs.* (ii) due to the enrollment cutoff around *Jun*1 (in ▸ Existing Literature)
   - compliers at *Jan*1 and *Jun*1 cutoffs differ in school-readiness at age 6 – new evidence
   - effect, as expected, stronger at *Jan*1 for (less school-ready) boys

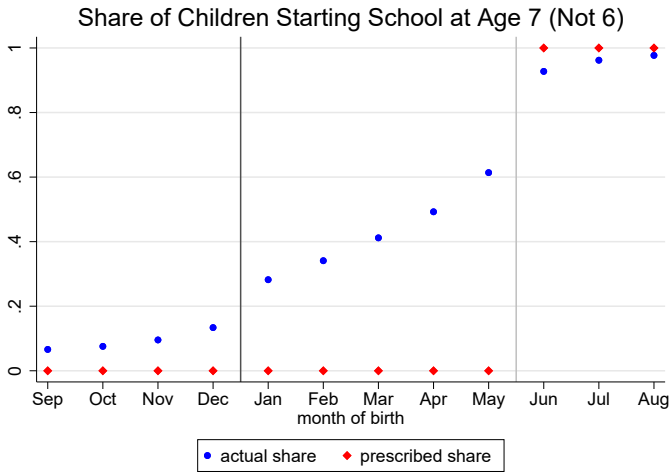
Roadmap for Talk

Goal: Identify and estimate the effect of starting school a year older due to *AR*

1. Context (Hungary)
2. Data (Administrative and Survey)
3. Identification (Fuzzy RD/IV) and Tests
4. First- and Second-Stage Estimates
5. Mechanism: Negative Selection into *AR* / Non-School-Readiness
   - Indicators of developmental obstacles in early childhood predict *AR*
   - Compliers around *Jan*1 cutoff had more developmental obstacles in early childhood
   - Boys had more developmental obstacles, overrepresented among compliers at *Jan*1
   - Significantly positive estimates of *AR* only present for boys
   - Point estimates due around *Jan*1 indeed larger for boys than around *Jun*1

Context

Share of Children Starting School at Age 7, by Month of Birth, in Hungary



Source of data: Hungarian National Assessment of Basic Competences (Grade 10), 2008-2017.

Hungarian Context

- Free (mostly public) childcare, compulsory for one year, most attend for 3 years
- Redshirting is very prevalent; but, conditional on early childhood markers, high-status are not more (or less) likely to redshirt
- Free (mostly) public schools

Data

Data

SSA, Time in Daycare, Month of Birth, Math and Reading Testscores, Secondary School Track, Aspirations for Highest Educational Attainment, Background Chars.

- National Assessment of Basic Competences (HNABC); 2008–2017, grades 6/8/10

Self-reported *MH* (Anxiety, Mental Exhaustion, Confidence and Experiences of Being Bullied in Class), and Early Childhood Shocks, Indicators of School-Readiness

- Hungarian Life Course Survey; 2006, grade 8

Drug Expenditures on Psycholeptics (ATC code *N*05)

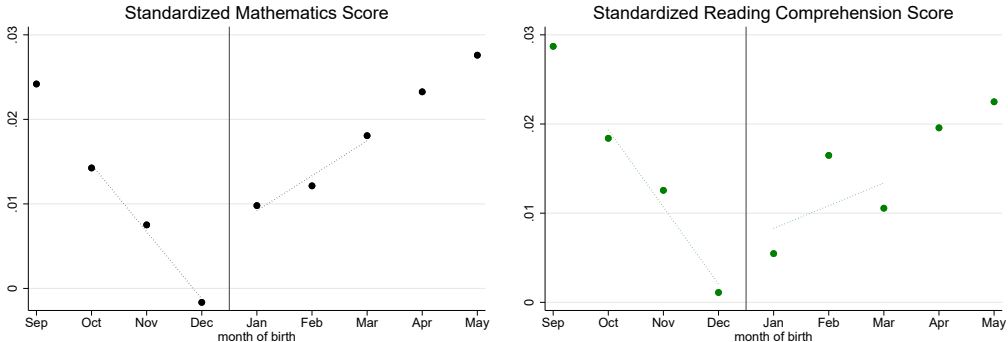
- HNABC Linked with Public Drug Expenditures; 2008-2017, grade 8

High School Graduation

- HNABC Linked with Graduation Information

Descriptives

Raw Reduced-Form: Student Achievement by Month of Birth in Hungary, 2008-2017



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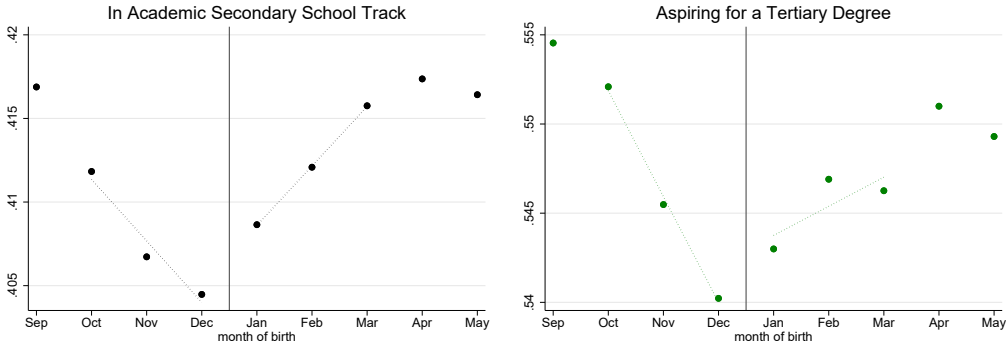

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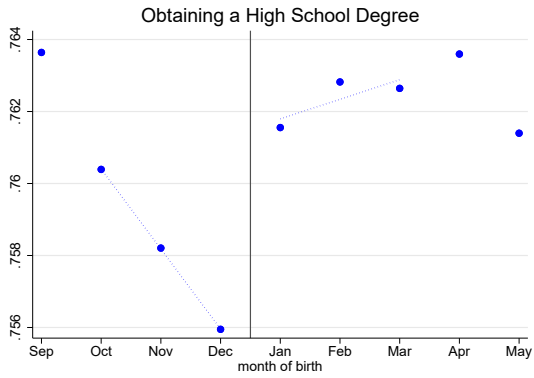

Source of data: Hungarian National Assessment of Basic Competences (Grade 10), Linked to Admin. Graduation Data for students and cohorts who had a chance to graduate by 2017.

Identification

Identification: IV Setup in Two Stages // Fuzzy RDD with Month of Birth

The 2SLS First-Stage and Second-Stage Equations:

$$\begin{aligned}\mathbb{1}\{\text{start school at 7}\}_i = \quad & \beta_0^d + \beta_1^d \mathbb{1}\{\text{birth-month}_i \geq x_d\} + \beta_2^d \text{birth-month}_i + \\ & \beta_3^d \mathbb{1}\{\text{birth-month}_i \geq x_d\} \times \text{birth-month}_i + \beta_4^d C_i + F_{ti} + \eta_i \end{aligned} \tag{1}$$

$$\begin{aligned}Y_i = \quad & \gamma_0^d + \gamma_1^d \mathbb{1}\{\text{start school at 7}\}_i + \gamma_2^d \text{birth-month}_i + \\ & \gamma_3^d \mathbb{1}\{\text{birth-month}_i \geq x_d\} \times \text{birth-month}_i + \gamma_4^d C_i + F_{ti} + \upsilon_i \end{aligned} \tag{2}$$

[1] Y_i: outcome of child i; $\mathbb{1}\{\text{start school at 7}\}_i$: dummy indicating starting school at age 7 (*vs.* 6);
[2] X_i is month of birth (linear trend, re-centered at x_d); discontinuity point x_d is either *Jan*1 or *Jun*1 for starting school at age 7 due to *AR* and the school enrollment cutoff, respectively; $1\{X \geq x_d\}$: discontinuity dummy;
[3] C_i: vector of background control variables (parents' education, income, HH size, geography);
[4] F_t: set of academic year dummies (defined to start in Sept. and end in Aug.);
[5] standard errors clustered at the school-level.

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ID Requirements: IV: *relevant*; as good as randomly assigned (*independence*); has no direct relationship to Y (*exclusion restriction*); effect in one direction (*monotonicity*).

Remarks on Identification, Inference, and Compliers

1. LATE estimate of starting school a year older, at age 7, due to AR is:
   - the reduced-form "jump" in a given outcome Y, rescaled by the first-stage "jump" in the share of redshirted children, around the birthdate of $Jan1$
2. I include children born in a 3-month window around the cutoff — a 1-month window is not sufficient for accounting for linear trend in X
3. As I look at tests taken at a given grade, a collinearity holds (in months): $SSA + \textit{months since primary school entry} = \textit{age-at-the-test}$
   - setup not suitable for disentangling SSA from *age-at-the-test* (same testdate)
4. I cluster standard errors at the school-level (most conservative, even when accounting to discrete running variable)

Results

First-Stage Estimates on Starting School at Age 7 (Grade 8 and 10)

outcome: $\mathbb{1}\{$**start school at 7**$\}$	***School Start at 7 Due to Academic Redshirting*** *cutoff* x_d : *January 1*		**School Start at 7 Due to *Enrollment Cutoff Date*** *cutoff* x_d : *June 1*	
	grade 8	grade 10	grade 8	grade 10
$Z = 1\{$**birth date** $X \geq x_d\}$	0.1243***	0.1119***	0.1923***	0.2141***
	[0.003]	[0.003]	[0.004]	[0.004]
R^2	0.1679	0.1412	0.3243	0.3389
N	341,964	334,767	356,691	343,272
baseline mean of Y	*0.0986*	*0.0929*	*0.5417*	*0.5010*

Source of data: Hungarian National Assessment of Basic Competences (Grades 8 and 10), 2008-2017.

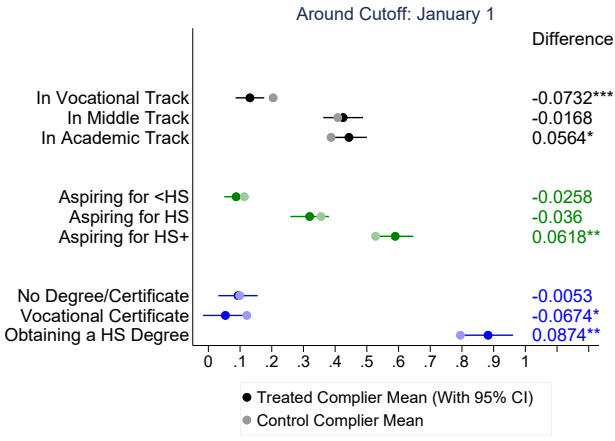
2^{nd}-Stage/LATE Estimates on Mathematics Test Scores (Grade 8 and 10)

	School Start at 7 Due to Academic Redshirting *cutoff x_d : January 1*		***School Start at 7 Due to Enrollment Cutoff*** *cutoff x_d : June 1*	
	grade 8	grade 10	grade 8	grade 10
$\mathbb{1}\{$**start school at 7**$\}$	0.1448***	0.1220**	0.1482***	0.1393***
	[0.054]	[0.056]	[0.033]	[0.030]
R^2	0.2226	0.2433	0.2330	0.2489
N	341,803	334,552	356,517	343,060

Source of data: Hungarian National Assessment of Basic Competences (Grades 8 and 10), 2008-2017.

2^{nd}-Stage/LATE Estimates on *HS* Track Choice, Aspirations, Graduation

Control Complier and Treated Complier Means Following Abdulkadiroglu et al. (2018)



Source of data: Hungarian National Assessment of Basic Competences (Grade 10), 2008-2017; also linked to Admin. Graduation Data for students and cohorts who had a chance to graduate by 2017.

Tests for ID

Identification Tests and Robustness

1. Non-smooth distribution of births around the cutoffs? – Share of boys, of children with low-educated parents and other background characteristics, and with developmental obstacles in early childhood do not change discontinuously
2. Cutoffs affect not only SSA but also childcare-starting age and years in childcare? – Estimates robust to accounting for endogenous years in childcare
3. School administrators, teachers, parents compensate redshirted children with more resources? – No evidence for remedial tutoring or help with homework

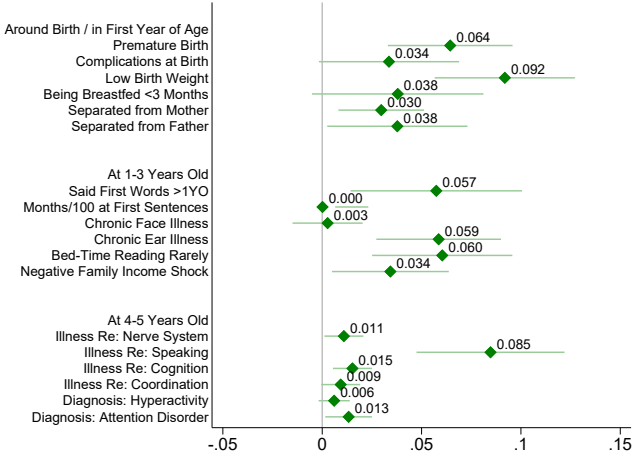
Results robust to:

- Functional form of trend, window length around cutoffs
- Horse-racing starting school at the age of 7 with relative age effects in class

Mechanisms

Negative Selection into Redshirting: Non-School-Readiness

For All Children – Indicators of Developmental Obstacles in Early Childhood (1-5yo) Predict Redshirting (6yo)



Source of data: Survey data – Hungarian Life Course Survey.

Negative Selection into Redshirting: Non-School-Readiness

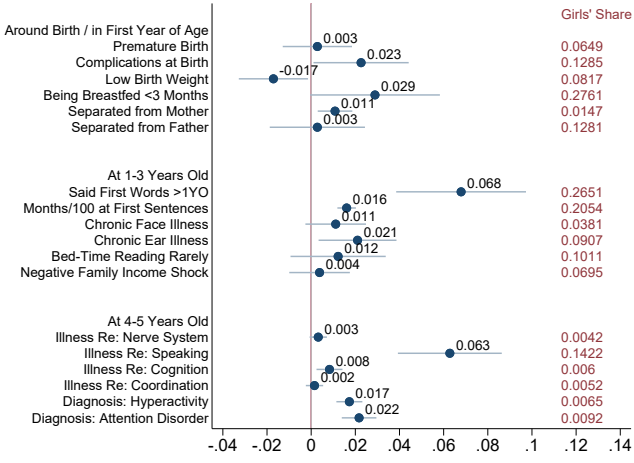
Average Characteristics of Compliers (Following Almond and Doyle (2011)), and P-Values of Differences in Shares

	(1)	(2)	(3)	(4)	(5)	(6)
	cutoff x_d : January 1 for Academic Redshirting			*cutoff x_d : June 1* School Enrollment Cutoff		
	compliers	**sample**	***p* (1)-(2)**	**compliers**	**sample**	***p* (4)-(5)**
gender: boy	0.5547	0.5046	0.004	0.4035	0.5101	0.002
said first words >1y	0.3612	0.3128	0.003	0.2531	0.3096	0.006
age (months): said first sent.	23.07	21.77	0.000	20.45	21.74	0.000
chronic face illness (<3y)	0.0648	0.0476	0.029	0.0523	0.0497	0.810
chronic ear illness (<3y)	0.1436	0.1102	0.004	0.1053	0.1147	0.515
problems w/ nerv.sys. (4-5y)	0.0123	0.0068	0.063	0.0011	0.0063	0.135
problems w/ speaking (4-5y)	0.2178	0.1889	0.056	0.1349	0.1786	0.012
attention disorder (4-5y)	0.0482	0.0182	0.001	0.0036	0.0280	0.000

Source of data: Survey data – Hungarian Life Course Survey.

Negative Selection into Redshirting: Non-School-Readiness

...Especially for Boys – Boys More Likely to Have Developmental Obstacles in Early Childhood



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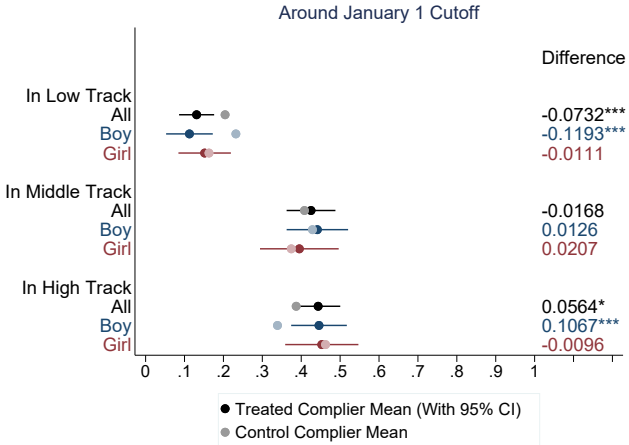
LATE Estimates of Starting School at Age 7 due to Redshirting, by Gender

Significantly Positive Estimates on Student Achievement Outcomes Are Only Present for Boys – HS Tracks



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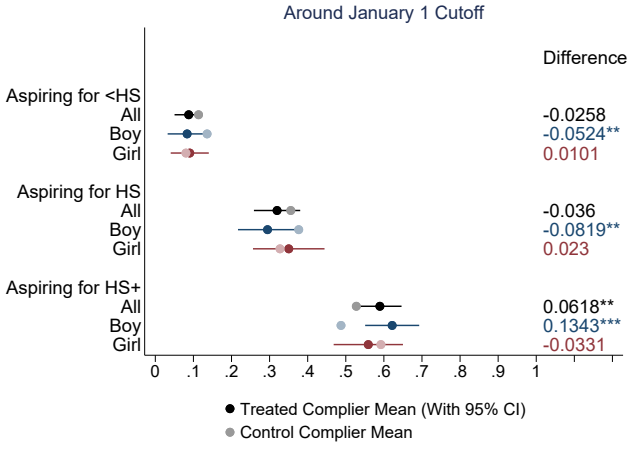

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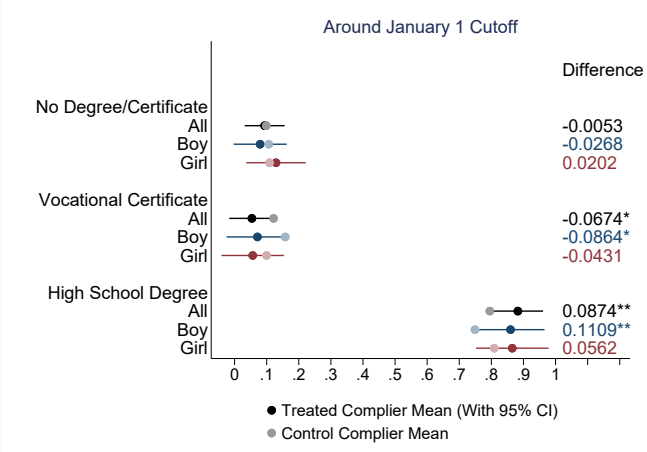

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LATE Estimates of Starting School at 7 Due to *AR* and Enrollment Cutoff

Point Estimates Due to Redshirting Indeed Bigger for Boys, Than Estimates Due to Enrollment Cutoff

	Due to Academic Redshirting *cutoff x_d : January 1*			***Due to Enrollment Cutoff Date*** *cutoff x_d : June 1*		
high school tracks:	*low*	*middle*	*high*	*low*	*middle*	*high*
$\mathbb{1}$ {**start school at 7**}	-0.1193***	0.0126	0.1067***	-0.1021***	0.0223	0.0797***
	[0.0306]	[0.0403]	[0.0365]	[0.0214]	[0.0303]	[0.0273]
Y in grade 10*:*	*math*	*reading*	1{*repeat*}	*math*	*reading*	1{*repeat*}
$\mathbb{1}$ {**start school at 7**}	0.1960***	0.2469***	-0.0941***	0.1596***	0.2045***	-0.0743***
	[0.0733]	[0.0727]	[0.0265]	[0.0570]	[0.0552]	[0.0200]
high school graduation:	*dropout*	*voc*	*HS*	*dropout*	*voc*	*HS*
$\mathbb{1}$ {**start school at 7**}	-0.0268	-0.0864*	0.1109**	0.0209	-0.0176	0.0219
	[0.0422]	[0.0492]	[0.0540]	[0.0291]	[0.0334]	[0.0361]

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LATE Estimates of Starting School at Age 7 due to Redshirting, by Gender

Significantly Positive Estimates on Mental Health Outcomes Also Present Only for Boys

	std.anxiety score	*often feeling anxious*	*log(exp.) N05*	*lack of confidence*	*bullied for: appearance*	*studies*
$\mathbb{1}\{$**start school at 7**$\}$	-1.1614**	-0.4555**	-0.0398**	-0.5021**	-0.3993*	-0.3272*
	[0.5101]	[0.2204]	[0.0181]	[0.2476]	[0.2278]	[0.1860]
N	38,516	38,516	62,027	38,480	38,489	38,496
control compl. mean		0.5149		0.7604	0.3445	0.3732
1^{st}*-stage F-statistic:*	*39.44*	*39.44*	*435.54*	*39.2*	*39.6*	*39.5*

Source of data: Hungarian Life Course Survey and 50 percent of the administrative test score data – Hungarian National Assessment of Basic Competences (grade 8) 2009-2017, linked with drug expenditures data.

Conclusion

Conclusion

- Starting school a year older, at age 7 not 6, due to redshirting significantly improves student achievement in high school
- Redshirted less likely to be school-ready; boys overrepresented
- Positive effects driven by boys; for boys, mental health is an important mechanism
- Academic redshirting sets boys—but not girls—up to be college-bound in high school tracks, and narrows the high school completion gap by 60 percent

Thank you for your attention! – molnartl@ceu.edu

Main Lessons from Existing Literature

On the Effect of Higher *SSA*, Due to Compliance with the School Enrollment Cutoff Date

1. Uses variation in *SSA* from age and birthdate cutoffs (potentially by geography):
   Elder & Lubotsky (2009); Barua & Lang (2016); Puhani & Weber (2009), Attar & Cohen-Zada (2018)
2. Students with higher *SSA* due to the enrollment cutoff perform better in school
   achievement tests: Altwicker-Hamori & Kollo (2012); Crawford et al. (2010); Dong (2010); Dhuey et al. (2019); Fredriksson & Ockert (2014); McEwan & Shapiro (2008); Smith (2009); Datar (2006); grade repetition, *HS* track: Muhlenweg & Puhani (2010); receptive vocabulary: Gorlitz et al. (2022)
3. Students with higher *SSA* have better noncognitive/behavioral outcomes
   ADHD, crime, teenage pregnancy: Black et al. (2011); Cook & Kang (2016); Landerso et al. (2017); Evans et al. (2010); Muhlenweg et al. (2012); Dee & Sievertsen (2015)
4. Evidence of the effect of higher *SSA* on adult and long-term outcomes is mixed
   IQ, wages, labor supply: Black et al. (2011); Dobkin & Ferreira (2010); Fredriksson & Ockert (2014)
5. Relative age effects related to performance, unclear if important above *SSA*
   Dhuey & Lipscomb (2008, 2010); Bedard & Dhuey (2006); Pena (2017); Sprietsma (2010); Schneeweis & Zweimuller (2014); Cascio & Schanzenbach (2016); Aliprantis (2014)