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Young and innocent
International evidence on age effects within grades on victimization in elementary school

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ABSTRACT

I examine the impact of age within grade on victimization in elementary school in 17 countries. Identification relies on the instrumental variables approach drawing on school entry age rules. The results indicate that children are harmed by being the youngest.

1. Introduction

School entry age effects on *cognitive* outcomes are well documented for many countries (e.g. Bedard and Dhuey, 2006; Cascio and Lewis, 2006; Kawaguchi, 2010; Mühlenweg and Puhani, 2010). Less is known on age effects on the development of personality.[1] The recent human capital literature emphasizes the multi-dimensionality of skills. Cognitive as well as non-cognitive (including social) skills determine labor market success. Therefore, the present 'letter' examines age effects on *social* outcomes.[2]

Precisely, the question of interest is whether children suffer from being the youngest *within* grade. For example harm is done if younger children are more often victims of school violence. Age effects are identified following the above-mentioned instrumental variables literature. The children's age position within class at a specific point in time is exogenously determined by rules implying a cut-off date for school entry with respect to children's month of birth.

Based on data for 17 countries, I demonstrate that the youngest children suffer from school victimization. Age effects on test scores and age effects on victimization are negatively correlated. Less favorable social outcomes due to age often seem to go hand in hand with less favorable test performance.[3] Some countries seem to handle students' age disadvantage better than other systems.

The paper proceeds as follows: Section 2 introduces the data-base and the identification strategy. Regression results are discussed in Section 3. Section 4 concludes.

2. Data and identification

I use the Progress in International Reading Literacy Study 2006 (PIRLS 2006) including student level information and results from a reading literacy test for 40 countries. Children are mostly about ten years old and observed in fourth grade.[4] Test scores are standardized to an international mean of 500 and a standard deviation of 100. For my analysis, I divide test scores by the international standard deviation.

PIRLS provides self-reported information on school victimization. I consider binary variables indicating that within the last month in school "something was stolen" from the child, whether the child was "bullied by another student", or whether the child was "injured by another student". I also aggregate a binary variable indicating whether any of these events happened. Only few observations are missing (2% for the aggregated indicator).

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[1] Dhuey and Lipscomb (2008) identify relative age effects on high school leadership.

[2] Development psychologists state that non-cognitive skills are predominantly determined in *early* childhood. This paper examines whether an institutional set-up might influence non-cognitive outcomes while in school.

[3] It is not within the scope of this paper to disentangle channels of interactions of cognitive and non-cognitive development.

[4] In Scotland and England students are in fifth grade.

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Table 1
School entry age rules and outcome variables.

Country	Cut-off	Age at cut-off	Test score	Victimization	"Things stolen"	"Being bullied"	"Being hurt"	Obs.
Austria	September (beginning)	6	5.37 (0.60)	0.43 (0.50)	0.24 (0.42)	0.20 (0.40)	0.25 (0.43)	5067
Belgium (Flemish)	December (end)	6	5.48 (0.51)	0.57 (0.49)	0.19 (0.39)	0.38 (0.49)	0.40 (0.49)	4479
British Columbia	December (end)	6	5.59 (0.65)	0.54 (0.50)	0.29 (0.45)	0.28 (0.45)	0.30 (0.46)	4150
Nova Scotia	October (beginning)	6	5.38 (0.73)	0.54 (0.50)	0.29 (0.45)	0.31 (0.46)	0.28 (0.45)	4436
Ontario	December (end)	6	5.40 (0.69)	0.63 (0.48)	0.32 (0.47)	0.37 (0.48)	0.40 (0.49)	3988
Québec	October (beginning)	6	5.32 (0.61)	0.57 (0.50)	0.36 (0.48)	0.27 (0.44)	0.32 (0.47)	3748
England	August (end)	5	5.36 (0.83)	0.59 (0.49)	0.27 (0.44)	0.30 (0.46)	0.40 (0.49)	4036
France	December (end)	6	5.23 (0.63)	0.56 (0.50)	0.33 (0.47)	0.31 (0.46)	0.31 (0.46)	4404
Iceland	December (end)	6	5.11 (0.64)	0.44 (0.50)	0.16 (0.37)	0.29 (0.46)	0.24 (0.43)	3673
Italy	December (end)	6	5.51 (0.63)	0.45 (0.50)	0.29 (0.45)	0.22 (0.42)	0.15 (0.36)	3581
Luxembourg	September (beginning)	6	5.57 (0.63)	0.44 (0.50)	0.18 (0.38)	0.21 (0.40)	0.26 (0.44)	5101
Norway	December (end)	6	4.97 (0.64)	0.34 (0.47)	0.10 (0.31)	0.19 (0.39)	0.20 (0.40)	3837
Poland	December (end)	7	5.24 (0.71)	0.32 (0.46)	0.14 (0.35)	0.15 (0.36)	0.16 (0.37)	4854
Scotland	August (mid)	5	5.30 (0.75)	0.54 (0.50)	0.22 (0.42)	0.27 (0.45)	0.35 (0.48)	3775
Singapore	January (beginning)	6	5.54 (0.75)	0.59 (0.49)	0.35 (0.48)	0.34 (0.47)	0.28 (0.45)	6390
Slovakia	September (beginning)	6	5.35 (0.70)	0.50 (0.50)	0.22 (0.41)	0.36 (0.48)	0.20 (0.40)	5380
South Africa	December (end)	6	2.93 (1.15)	0.80 (0.40)	0.59 (0.49)	0.47 (0.50)	0.42 (0.49)	14,657
Spain	December (end)	6	5.16 (0.66)	0.59 (0.49)	0.29 (0.45)	0.22 (0.42)	0.44 (0.50)	4094
Sweden	December (end)	7(6)	5.49 (0.60)	0.32 (0.47)	0.14 (0.35)	0.13 (0.33)	0.21 (0.41)	4394
Taiwan	August (end)	6	5.36 (0.60)	0.60 (0.49)	0.40 (0.49)	0.40 (0.49)	0.29 (0.45)	4589

Note: School entry regulations, means of outcomes (standard deviations) and number of observations.

Gender and birth month and year are known for all children. The primary source for school entry age regulations is the contextual data-base provided in PIRLS. I complement this information mainly based on ministry of education homepages and the Eurydice data-base.[5] I excluded countries where regulations are obviously not applied[6] and with significant regional variation in entry age. Regulations implying a cut-off month for school entry are verified for 17 countries including four Canadian provinces. On average about 4900 children are observed per country.

Table 1 provides an overview of these regulations and means of outcome variables. In most countries children are supposed to enter school in the calendar year when they turn six. In some countries the cut-off month is September: Children born before September are supposed to enter school in the year when they turn six; children born between September and the end of December enter in the year they turn seven.

Table 1 demonstrates significant variation related to school victimization: Victimization is highest in South Africa (80% of children suffer from some kind of victimization) and lowest in Poland and Sweden (32%).

Age within grade is endogenous to the outcomes if entry age regulations are not strictly applied: If for example children with behavioral problems may enter school later this might drive the correlation of age and the outcomes. Endogeneity of age calls for an instrumental variables strategy. I use the official entry age rules based on birth month as an instrument for students' age within grade. Assigned entry age is a valid instrument if birth month is exogenous to the outcomes. However, there might be direct effects of season of birth on child development (Bound et al., 1995). In order to eliminate seasonal effects, I additionally control for season of birth. I start with estimating the following equations by Two-Stage-Least-Squares for the pooled sample of the 17 countries:

$$age = \alpha\ thage + \beta\ f(bmonth) + \gamma\ countries + \eta \text{ and} \tag{1a}$$

$$outcome = \delta\ \hat{age} + \zeta\ f(bmonth) + \theta\ countries + \varepsilon, \tag{1b}$$

where *age* is the observed relative age of a student (defined as the deviation from the mean age within grade) and *thage* is the theoretical relative age (according to the school entry age rule). Furthermore, $f(bmonth)$ is a function of month of birth and *countries* refers to a column vector of binary country indicators. I use the pooled sample of countries since only this allows controlling for seasonal effects. If estimation were conducted separately for each country there would be hardly any independent variation of season of birth and relative age within grade.

As a basic specification for $f(bmonth)$ I use a fourth order polynomial of birth month to control for seasonal effects. I present robustness checks where birth month dummy variables as well as

[5] Detailed sources are available upon request from the author.

[6] As a formal criterion, I excluded countries where regressing children's age on the theoretical age as determined by the school entry regulation yielded coefficients of less than 0.5.

quarter of birth indicators are used respectively. Additionally, I present a specification where absolute age at school entry (indicating at which age children regularly enter school in a country) is used as a regressor.

Two-Stage-Least-Squares estimation identifies age effects for compliers with the entry rules. How do these local average treatment effects (LATE) generalize to average treatment effects (ATE)? As a check, I use the control function approach following Card (2001) which yields consistent estimates generalizing to the ATE under its functional form assumptions.

I further try and address how the presented estimates differ by country. Therefore, I show the 2SLS estimates from regressions conducted on the country level (as in Eq. (1) but without country indicators and season of birth controls). I also show results for sets of countries by the educational regime (again including country indicators): First of all I distinguish between countries where (a) reading is taught to all children based on the same curriculum without addressing different levels of ability and (b) countries where there is a joint curriculum but this curriculum allows for some differentiation by ability level. This information is directly feasible from the PIRLS contextual data-base.

A second classification distinguishes four types of systems by the way in which students' heterogeneity is managed (following Dupriez et al., 2008): (a) In the separation model students are prepared for education in segregated secondary school tracks (Austria, Belgium, Luxembourg, Slovakia in this paper). (b) In comprehensive systems schools are generally comprehensive with a common core curriculum while there might be some ability grouping for example within classes or by flexible grouping (Canada, England and Scotland). (c) Uniform integration models refer to comprehensive schools without any differentiation (France, Italy, Spain). Finally, (d) individualized integration models are also comprehensive systems without ability grouping but with different forms of differentiation, for example individualized teaching (Iceland, Norway, Poland, Sweden).[7] Note that for regressions according to the second classification, it is not feasible to control for season of birth in addition to student's relative age since entry age regulations hardly vary within the respective sub-groups.

3. Results

Table 2 presents 2SLS results based on data for the pooled sample of countries. The first panel of Table 2 presents highly significant first stage coefficients on the instrument (cf. Eq. (1a)) which bolsters confidence in the instrument. Secondly, children who are about a year older score 0.3 test score standard deviations higher compared to younger children. The overall probability to suffer from victimization is reduced by eight percentage points for older children. Younger children are significantly more likely to get something stolen, to be bullied and to be hurt. The absolute size of the point estimates is mostly higher for boys than for girls. Table 2 also shows results for the different specifications related to the season of birth, the inclusion of absolute age as well as a control function estimate (CF) and thus demonstrates robustness of the results.[8]

Table 3 presents the results separately by country. Again, 2SLS estimation yields positive age effects on test scores for each country. Point estimates range from 0.12 test score standard deviations (South Africa) to 0.49 standard deviations (Scotland). The point estimates of the age effect on the probability of victimization are mostly negative with highest absolute effects related to the aggregated indicator for

Table 2
Age effects on test scores and school victimization, robustness checks.

Specification	First stage	Test score	Victimization	"Things stolen"	"Being bullied"	"Being hurt"
Polynomial	0.84**	0.30**	−0.08**	−0.05**	−0.09**	−0.06**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Polynomial, *male*	0.84**	0.35**	−0.10**	−0.08**	−0.10**	−0.08**
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Polynomial, *female*	0.84**	0.24**	−0.06**	−0.02	−0.08**	−0.04**
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
No season control	0.83**	0.27**	−0.07**	−0.04**	−0.07**	−0.05**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Seasons	0.84**	0.29**	−0.08**	−0.05**	−0.09**	−0.06**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Birth month	0.84**	0.30**	−0.08**	−0.05**	−0.09**	−0.06**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Polynomial +	0.84**	0.30**	−0.08**	−0.05**	−0.09**	−0.06**
absolut age	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Polynomial, CF	0.84**	0.29**	−0.08**	−0.05**	−0.09**	−0.06**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)

Note: Results refer to 2SLS estimates of the age effects (Eq. (1)). Standard errors in parentheses. Male and female refer to results for sub-samples by gender. Season of birth is considered in optional specifications. The standard specification ("Polynomial") is a fourth order polynomial of birth month. "No season control" indicates that season of birth is not included. "Seasons" indicates that quarter of birth indicators are used and "birth month" refers to birth month dummy variables. "Absolute" refers to the country's usual school entry age which is included as additional regressor. CF indicates the control function estimate as a further robustness check.*Significant at the 10% level. **Significant at the 5% level.

Table 3
Age effects by country.

Country	First stage	Test score	Victimization	"Things stolen"	"Being bullied"	"Being hurt"
Austria	0.58**	0.15**	−0.02	0.01	0.00	−0.03
	(0.03)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)
Belgium	0.72**	0.21**	−0.11**	−0.04	−0.07*	−0.08*
(Flemish)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)
Canada, British	0.88**	0.27**	−0.04	−0.01	−0.06*	−0.05
Columbia	(0.02)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Canada, Nova	0.79**	0.26**	−0.09**	−0.06*	−0.04	−0.08**
Scotia	(0.02)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Canada, Ontario	0.91**	0.28**	−0.09**	−0.08*	−0.03	−0.07*
	(0.01)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Canada, Québec	0.83**	0.28**	−0.04	−0.05	−0.01	−0.03
	(0.03)	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)
England	0.95**	0.38**	−0.08**	−0.05	−0.10**	−0.04
	(0.01)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
France	0.81**	0.27**	−0.11**	−0.06*	−0.09**	−0.08**
	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)
Iceland	0.98**	0.30**	−0.02	0.00	−0.03	−0.03
	(0.01)	(0.04)	(0.03)	(0.02)	(0.03)	(0.03)
Italy	0.81**	0.27**	−0.04	−0.01	−0.06*	0.01
	(0.03)	(0.05)	(0.04)	(0.03)	(0.04)	(0.03)
Luxembourg	0.71**	0.15**	−0.04	0.00	−0.02	−0.02
	(0.03)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Norway	0.98**	0.26**	0.00	0.02	−0.03	0.01
	(0.01)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Poland	0.97**	0.23**	−0.05**	−0.01	−0.02	−0.02
	(0.01)	(0.04)	(0.03)	(0.02)	(0.02)	(0.02)
Scotland	0.74**	0.49**	−0.09*	−0.03	−0.19**	−0.02
	(0.03)	(0.06)	(0.05)	(0.04)	(0.04)	(0.05)
Singapore	0.98**	0.15**	−0.04	0.02	−0.10**	−0.04*
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Slovakia	0.63**	0.21**	−0.07	−0.04	−0.08**	0.00
	(0.03)	(0.06)	(0.04)	(0.04)	(0.04)	(0.03)
South Africa	0.65**	0.12*	−0.04	−0.03	−0.02	−0.02
	(0.04)	(0.06)	(0.02)	(0.03)	(0.03)	(0.03)
Spain	0.94**	0.27**	−0.10**	−0.09**	−0.04	−0.11**
	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
Sweden	0.89**	0.24**	−0.06*	−0.04*	−0.05**	−0.05**
	(0.02)	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)
Taiwan	0.90**	0.30**	−0.10**	−0.07**	−0.15**	−0.11**
	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)

Note: Results refer to 2SLS estimates of the age effects separately by country. Estimation by country does not allow for inclusion of season of birth. Standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level.

[7] I do not categorize Singapore, South Africa and Taiwan in order to have four rather homogeneous groups of countries according to the given classification.

[8] The point estimates (not shown here) point to a negative absolute age effect with respect to school victimization: School victimization seems to be (insignificantly) more frequent in countries with a generally higher official age at school entry.

Table 4
Age effects for sub-sets of countries (2SLS).

Sub-groups	First stage	Test score	Victimization	"Things stolen"	"Being bullied"	"Being hurt"
Classification 1: According to reading curriculum						
Consideration of ability levels	0.90**	0.30**	−0.06**	−0.02*	−0.07**	−0.02
	(0.01)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)
No consideration of ability levels	0.79**	0.24**	−0.08**	−0.05**	0.06**	−0.07**
	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
Classification 2: According to treatment of students' ability						
(a) Separation model	0.64**	0.20**	−0.06**	−0.02	−0.05**	−0.04*
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
(b) Comprehensive model	0.92**	0.35**	−0.08**	−0.05**	−0.09**	−0.04**
	(0.01)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
(c) Uniform integration	0.84**	0.29**	−0.09**	−0.05**	−0.07**	−0.06**
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
(d) Individual integration	0.96**	0.22**	−0.05**	−0.01	−0.03*	−0.02
	(0.01)	(0.04)	(0.02)	(0.01)	(0.02)	(0.02)

Note: Results refer to 2SLS estimates of the age effects for sub-groups of countries (including country indicators as control variables). Regressions related to the first classification include the polynomial specification of month of birth. This is not feasible for the second classification because school entry cut-offs hardly vary within the respective countries. Standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level.

Belgium and France (−0.11), Spain and Taiwan (−0.10) and Nova Scotia (Canada), Ontario (Canada) and Scotland (−0.09). Even if the coefficients are not always statistically significant, Table 3 indicates that countries with high positive age effects on test scores tend to be characterized by high negative effects on victimization. The age effect on test scores and the age effect on victimization are correlated with a Bravais–Pearson coefficient of −0.4.

Some countries seem to handle students' age disadvantage better than others. This is addressed in Table 4 by looking at the different samples of countries according to classifications of the educational systems. Surprisingly, the relative age effect on the reading score is higher in countries where the reading curriculum may be applied to different levels of ability. However, even if the official regulations in all these countries allow addressing different abilities in the reading classes, the ways to address students' heterogeneity is very different in the included countries. The refined classification of heterogeneity treatment may be more insightful: This second differentiation suggests that the age effects on test scores as well as on school violence tend to be more severe in countries with a comprehensive system allowing (intra-class) ability grouping like Canada, England and Scotland. Age effects tend to be lower for integrative systems with individualized teaching like in northern European countries and in countries where children are prepared for different ability tracks (like in some central European countries).

4. Conclusions

Based on data for 17 countries, I show that older children within grades less often suffer from victimization. According to evidence from psychology (for example Cassidy, 2009) school victimization determines children's development of personality. Thus, it is very likely that being the youngest in class will affect future non-cognitive outcomes.

Even if the results shown for the different sub-sets of countries do not present causal evidence on the structure of the school systems, they suggest that age effects are highest for systems with generally comprehensive primary education like Canada and the U.K. However, in light of the heterogeneity in education systems, it is beyond the scope of this paper to explain the international differences in age effects.

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