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Working Paper

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

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International Evidence on Age Effects Within Grades on School Victimization in Elementary School

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Centre for European Economic Research

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Andrea M. Mühlenweg

Non Technical Summary

School entry age effects on (short-term) cognitive outcomes are well-documented in the economic literature for many countries. These studies do not consider school entry age effects on the development of personality or social outcomes. However, the recent human capital literature emphasizes the multi-dimensionality of skills. Cognitive as well as non-cognitive skills are important determinants of labor market success. This is why the present study examines age effects on social outcome variables. Specifically, available international school assessment data allow observation whether younger children are more often victims of school violence in elementary school.

Precisely, the question of interest in this study is whether children, as observed at one point in time, suffer from being the youngest *within* grade. Harm is done for example if the youngest children are more often bullied or are more often victims of any kind of school violence. Age effects are identified following the instrumental variables literature based on national school entry age rules. Possible selection into compliance with official rules is taken into account via the control function approach as a robustness check.

Based on the PIRLS data for 17 countries, this paper demonstrates that younger children within grades (due to entering school younger according to official school entry age regulations) are harmed in terms of school victimization. The size of point estimates of the age effect is mostly higher for boys than for girls and for children with an immigrant background than for native children. Additionally, the study considers whether countries with a high age effect on cognitive outcomes are also countries with high age effects on social outcomes. Along this line, I find that the social effects of age within grade tend to be higher in countries where there are also high age effects on the observed cognitive test scores. Less favorable social outcomes seem to go hand in hand with less favorable test performance.

Das Wichtigste in Kürze (German Summary)

Mehrere aktuelle bildungsökonomische Veröffentlichungen befassen sich mit den (kausalen) Auswirkungen des Einschulungsalters auf den weiteren schulischen Erfolg und die kognitive Entwicklung. Diese Studien berücksichtigen jedoch nicht, dass neben der kognitiven Entwicklung die Persönlichkeitsentwicklung und soziale Ergebnisse relevant sind. Die neuere Humankapitalliteratur betont die Mehrdimensionalität von Fähigkeiten: Kognitive wie nicht-kognitive Fähigkeiten sind wichtige Determinanten der Höhe des Humankapitals. Deshalb beleuchtet die vorliegende Studie Alterseffekte in Bezug auf soziale Ergebnisse. Die Studie geht der Frage nach, ob Kinder, die zu einem bestimmten Zeitpunkt (in der vierten Klasse) beobachtet werden, darunter leiden, wenn sie die jüngsten in der Klasse sind. Vorliegende Schülerleistungsdaten ermöglichen es insbesondere zu analysieren, ob die jüngeren Schülerinnen und Schüler häufiger Opfer von Mobbing und Gewalt in der Schule werden.

Auf der Grundlage von Daten für 17 Länder, die an der Grundschullesestudie IGLU teilgenommen haben, zeigt sich folgendes: Die (auf Grund der entsprechenden Einschulung nach offiziellen Stichtagsregelungen) jüngeren Kinder innerhalb von Klassen haben eine signifikant höhere Wahrscheinlichkeit, von Mobbing oder Gewalt in der Schule betroffen zu sein, als die älteren. Dies gilt insbesondere für Jungen und für Schülerinnen und Schüler mit Migrationshintergrund. Betrachtet man die Effekte, die für die einzelnen Länder geschätzt werden, so zeigt sich eine positive Korrelation zwischen der Auswirkung des Alters auf die Leistungen in der Grundschullesestudie und dem Alterseffekt auf die sozialen Ergebnisse. Die Kinder, die auf Grund ihres Alters unter Mobbing/Gewalt leiden, erzielen demnach (aus dem gleichen Grund) tendenziell schlechtere Testergebnisse.

Young and Innocent

International evidence on age effects within grades on school victimization in elementary school

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Abstract: This study examines the impact of children's age within grade on school victimization in elementary school. Identification of age effects relies on the instrumental variables approach drawing on official school entry age rules based on children's month of birth. The empirical analysis uses the PIRLS data for 17 countries where such school entry age rules are effectively applied. Possible selection into compliance with official entry rules is taken into account via a control function approach. The study demonstrates that children are causally and significantly harmed by being the youngest within grade. Sub-group analysis reveals that the size of age effects on school victimization tends to be higher for boys than for girls as well as for children with an immigrant background compared to natives. The point estimates suggest that the age effect on school victimization is especially high in countries where there are also high effects on the cognitive outcome variable.

JEL classification: I21

Keywords: education, segregation, school effects

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1 Introduction

Positive effects of age at school entry on (short-term) cognitive outcomes are well-documented in the economic literature for many countries (cf. for example Bedard and Dhuey, 2006; Cascio and Lewis, 2006; Puhani and Weber, 2006; Kawaguchi, 2009; Mühlenweg and Puhani, 2010). None of these studies considers school entry age effects on the development of personality or social outcomes. However, the recent human capital literature emphasizes the multi-dimensionality of skills (e.g. Cunha et al., 2006). Cognitive as well as non-cognitive skills (including social skills) are important determinants of labour market success. This is why the present study examines age effects on social outcome variables for pupils in a large set of countries. Specifically, available international school assessment data allow observation whether younger children are more often victims of school violence in elementary school.[1]

Age effects are identified following the instrumental variables literature based on official school entry age rules (as introduced in Angrist and Krueger, 1992). Possible selection into compliance with official entry rules is taken into account via a control function approach as a robustness check (cf. Card, 2001). Precisely, what this paper is interested in is not the *absolute* effect of school entry age on children's performance (for example comparing the performance of children entering at age 6 and those entering at age 7). As noted recently for example in Angrist and Pischke (2009) this effect may not be properly identified based on student data. The question of interest in this study is whether children, as observed at one point in time, suffer from being the youngest *within* grade. Harm is done for example if the youngest children are more often bullied or are more often victims of any kind of school violence.[2]

Based on data for a large set of countries, this paper demonstrates that younger children within grades (due to entering school younger according to official school entry age regulations) are harmed in terms of school victimization. The size of point estimates of the age effect is mostly higher for boys than for girls and for children with an immigrant background than for native children. Additionally, the study considers whether countries with

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[1] Among development psychologists, there seems to be a consensus that non-cognitive skills are predominantly determined in *early* childhood. Thus, the present application is also an example of an examination whether an institutional set-up (i.e. school entry age regulation) might influence the formation of personality during the schooling years.

[2] Beside possible non-cognitive effects related to such social outcomes and their influence on the development of personality cognitive effects of age within grade might also be crucial. For example in countries with a system of secondary school tracking, students are typically evaluated at one point in time and accordingly selected to different secondary school tracks. Therefore, poorer cognitive performance of younger children within grade crucially affects those children's future education perspectives (cf. Mühlenweg and Puhani, 2010 for such evidence related to a school tracking system).

a high age effect on cognitive outcomes are also countries with high age effects on social outcomes. Along this line, I find that the social effects of age within grade tend to be higher in countries where there are also high age effects on the observed cognitive test scores. Less favorable social outcomes seem to go hand in hand with less favorable test performance.[3]

The paper proceeds as follows: Section 2 introduces the data base and is followed by Section 3 on stylized facts and a review of the empirical method to identify age of school entry effects. The according regression results and robustness checks are discussed in Section 4. Section 5 concludes.

2 Data

The major data source used in this paper is the Progress in International Reading Literacy Study 2006 (PIRLS 2006). The original PIRLS data base provides data on children attending elementary schools in 40 countries including Canada with five separate samples for its provinces. Sample size varies by country: On average about 4,800 children are observed per country. Children within the observed grades are about ten years old, so that for most countries, data are collected in fourth grade of compulsory schooling. In two countries, South Africa and Luxembourg, the average students are somewhat older (about 11 years old). PIRLS includes information from students, parents and school questionnaires as well as children's results in the reading literacy test. Test outcomes are standardized to an international mean of 500 and a standard deviation of 100. For the purpose of the regression analysis, I further standardize the test score by dividing it by its standard deviation in order to facilitate the interpretation of the effect.

The PIRLS data base provides a set of social outcome variables indicating whether pupils suffer from school victimization. All these variables are reported by the children within the student background questionnaire. Specifically, the present study considers 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 she or he was "injured by another student". I also use an aggregated binary variable for school victimization indicating whether any of these three events happened to the child. For some children the social outcome variables are not observed but the number of such missing observations is relatively small (about 2 % for the aggregated variable in the estimation sample).

[3] It is not within the scope of this paper to disentangle interactions of cognitive and non-cognitive development. Thus, I present evidence with respect to the age effect on social outcomes as well as the age effect on test scores. I do not identify or discuss the channels of interaction between these effects.

As concerns student background variables, I do not use data from the parents' questionnaires since this would notably reduce sample sizes: Taking the average of all countries considered in this paper, parents' response rate for basic information amounts to 85 % but in some countries it is much lower (about 50 %). Therefore, restricting the samples to children whose parents answered a questionnaire would probably introduce selectivity. Information on students' background is thus solely drawn from the students' questionnaires. However, there is also a crucial number of missing observations for some variables observed in the students' questionnaire. Consequently, only key variables (favorably with a high response) rate are used. The first key variable is gender which is observed for 100 % of the children and verified via PIRS administered information. The second key variable is an indicator for immigrant background stating whether the child or one of the child's parents has been born abroad. This second variable is only available for 84 % of the children so that corresponding sub-group results have to be interpreted with a grain of salt. Furthermore, children's birth month and year of birth as well as the interview date (determining children's age in the observed grade) are drawn from the administered information. Actual age of school entry is deduced by subtracting time in school from the observed age at time of interview. Thus, possibilities of grade retention are ignored. I assume that this yield the exact age of school entry for the vast majority of children (frequencies of grade retention after first grade and up to fourth grade should be small in most countries). Furthermore, grade retention will be addressed in a robustness check.

Table 1 provides means and standard errors of central outcomes and control variables for each country and based on the estimation samples which will be used in Section 4. Notably, there is significant variation in the degree of school victimization between different countries: 81 % of children in South Africa indicate to suffer from some kind of school victimization while only 26 % of children in Poland report such problems.

Average compulsory school entry age is between 5.2 and 7.3 years in the relevant countries. In countries where children enter when they are about five years old (like Scotland and England) children are accordingly observed in the fifth (instead of the fourth) year of compulsory schooling in PIRLS. In most countries, the average child enters school at the age of six.

Besides the student level data of PIRLS, the further analysis requires information on national school entry regulations. The primary source for the national regulations is the contextual data-base which is directly provided in PIRLS (PIRLS 2006 Curriculum Questionnaire). I further verify and complement this information mainly based on information from national ministry of education homepages and the Eurydice data-base (www.eurydice.org).[4] Standard school entry age regulations which imply a cut-off month for school entry related to children's birth date are documented and verified for 17 countries for the given cohorts of children.[5] Table 2 provides an overview of the different school entry regulations with respect to the different cut-off dates in the 17 countries of interest.

3 Stylized Facts and Identification Strategy

A simple descriptive way to consider school age effects on school victimization is presented in Figure 1 based on the pooled data set including all 17 countries. This figure shows average test cores and social outcomes by relative age within grade (as deduced from the age structure in the observed school year).[6] There is a clear pattern that both the particular young as well as the particular old children within grade perform poorly in the PIRLS reading test and are most often subject to school violence. This evidence hints to the endogeneity of school entry age with respect to the outcomes considered: In countries where school entry regulations are not strictly applied, for example children with cognitive or behavioral problems may enter school later than prescribed by the official regulation and will make up the group of extremely late entrants. In light of parental discretion and possible grade retention, it is not surprising that the relatively old children achieve less favorable outcomes when observed in elementary school.

It is also worth observing that there is a somewhat different pattern related to the more regular aged school entrants within a one year age span around the average entrance age (85 % of children in the sample). Within this sample, there seems to be a tendency that relatively older students are *less* often subject to school violence (with a nearly linear trend).

The patterns observed are very similar for each gender and for children with and without an immigrant background. The corresponding means for all these sub-groups are

[4] All internet sources have been retrieved in February and March 2009. Detailed information on the sources is available upon request from the author.

[5] I excluded countries where such school entry age regulations exist but are obviously not applied. This is the case if eyeballing of school entry age by birth month demonstrates that the effectively used cut-off month is not the cut-off month stated in the national school regulation. As a formal criterion, I excluded all countries where regressing children's age in first grade on the entry age according to the regulation yielded coefficients of less than 0.5 years for the sample of pupils born a month prior or after the cut-off month ('regression discontinuity sample'). I also excluded countries with significant regional variation in school entry age regulations (for example the U.S. as well as Germany at the year of observation), since regions cannot be identified in the data. More information on this for all 40 PIRLS countries is available upon request from the author.

[6] Only the majority of children who enter school at most a year earlier and at least a year later than the average child are included. This criterion is met by 96 % of children. Older and younger children are not included in Figure 1 for practical reasons (scaling of the x-axis).

summarized in Table 3. Generally, girls' test scores are somewhat higher and the frequencies of school victimization are slightly lower (except for the extreme age groups). For example 51 % of averaged aged girls and 55 % of the boys report to be subject to any kind of school violence. At the same time, children without an immigrant background score somewhat higher and are less likely to be victims of school violence (again except for the extreme age groups). As for these children, 50 % of average aged children without immigrant background report not to experience school violence while 59 % of average aged immigrant children do so.

The evident endogeneity of age within grades calls for an instrumental variables strategy. Therefore, it is important to note that - besides parental and teacher's discretion - the age distribution within grades is mainly driven by national age of school entry regulations. Such official entry age rules typically imply a cut-off month for school entry so that assigned age at school entry depends on children's birth month. As shown in Table 2, in most countries the official rule is that children enter school in the calendar year when they turn six. This implies that the cut-off date for school entry is December, 31 (the end of the calendar year). In Austria and Slovakia for example, the cut-off month is September: Children born before September, 1 are supposed to enter school in the year when they turn six, while children born between September and the end of December, enter in the year they turn seven.

Assigned school entry according to the official regulations is a valid instrument for age within grades, assuming that month of birth is exogenous to educational and social outcomes. However, as summarized in Bound, Jaeger and Baker (1995), there might be direct effects of season of birth on the child's development. In order to eliminate such seasonal birth date effects on the outcome variables, I restrict the regression samples to children born one month before and after the school entry age cut-off date (discontinuity samples). [7]

Using Two-Stage-Least Squares (2SLS) estimation with birth month as an instrument identifies the age effect for the group of compliers with the official entry age rule in the sense of a local average treatment effect (LATE). Compliance with entry age rules is far from perfect in some countries. In order to deduce an impact for the entire population of children, the crucial question is how the LATE generalizes to an average treatment effect (ATE). In other words, the question is how compliers differ from non-compliers with the entry age rule. For example Puhani and Weber (2007) present some evidence for a negative correlation of the

[7] Concerning functional form I mainly use linear probability models. I also present a robustness check where 'probit IV' estimations are used for the school violence indicators (estimated using ivprobit with the marginal effects command in STATA 9.2).

degree of compliance and the size of the age effect on standardized test scores. This suggests that compliers are less affected by age effects than non-compliers.

In order to take possible selection to the group of compliers into account (i.e. compliers are affected in a different way than non-compliers), in a first (simple) robustness check I restrict the sample to countries with strict enforcement of the school entry age regulations. In this case, practically everyone is a complier. This also implies that countries with considerable numbers of grade retention are excluded. As a second robustness check, I use the control function approach as suggested by Card (2001) following Garen (1984). In principle, I thus estimate the following equations in two steps:

$$\hat{a}_i = \hat{\varepsilon} \cdot e_i(b_i) \quad (1)$$

$$\mathrm{y_i} = b_0 + b_1 a_i + b_2(\hat{a}_i - \hat{\varepsilon} \cdot e_i(b_i)) + b_3(\hat{a}_i - \hat{\varepsilon} \cdot e_i(b_i))a_i \quad (2),$$

where $\hat{a}_i$ is individual *i*'s prediction of observed age at school entry (a_i) from the first stage regression, $e_i(b)$ is assigned age at school entry for individual *i* which depends on birth month b_i and y_i is the outcome of interest (test scores or social outcomes). $\hat{\varepsilon}$, b_1, b_2, and b_3 are regression coefficients of the first and second step respectively. Second step estimation should accordingly yield a consistent estimate of the age effect (b_1).

4 Results

In order to pin down the overall effect of age within grade on test scores and social outcomes, Table 4 presents results from 2SLS estimation based on the pooled sample including all 17 countries. Since absolute age at school entry differs somewhat by country and I am not interested in the absolute age effect but in relative age within grade, estimation is based on relative age as the control variable. The first panel of Table 4 demonstrates that 2 SLS yields rather high and highly significant first stage coefficients. This underpins confidence in the instrument (assigned relative age implied by birth month) which is far from being a weak instrument. Secondly, a higher age within grade implies higher test scores: Children who are about a year older (that is for most countries: children who entered school when aged about seven instead of six years) score about 0.3 test score standard deviations higher compared to the younger children. With respect to school victimization, older children are also less likely to be victims of school violence. The overall probability to suffer from school violence is reduced by about nine percentage points for children being a year older. Accordingly, the estimated age coefficients are negative for all social outcome variables, i.e. younger children are significantly more likely to get something stolen, to be bullied and to be hurt. Sub-group analysis presented in Table 4 shows that the absolute size of point estimates of the age effects is higher for boys than for girls. For the social outcomes variables, the absolute size is additionally higher for children with an immigrant background than for natives.

To refine the analysis, results are furthermore estimated separately for each country (cf. Figure 2 and Table 5). Again, this yields positive effects of age within grade on reading test scores. Positive point estimates of the 2SLS regression range from 0.01 test score standard deviations (South Africa) to 0.49 standard deviations (Scotland). At the same time, most of the point estimates of the age effect on the probability of school victimization are negative (with the exception of a zero effect for Slovakia). The negative effects are highest for Ontario (-0.18), Scotland (-0.17) and England (-0.14). Even if these point estimates are not always significant in the statistical sense, Figure 2 suggests that countries with high positive age effects on cognitive outcomes also tend to be characterized by high negative effects on school violence. If the sample is reduced to countries where both the cognitive and the general school victimization effect are significant at least on the ten percent level, the pattern clearly remains the same (not shown here). The sample of countries where all these effects are significant consists of Scotland, England, Canada, Spain, France and Taiwan. The age effect on the reading score and the age effect on school victimization are correlated with a negative Bravais-Pearson correlation coefficient -0.62 in this sample.

The presented results from 2SLS regressions might be driven by the selectivity of the group of compliers. In order to check this, in a first step, the sample is reduced to countries with a high rate of compliance (first stage coefficients of 0.85 or more). Accordingly, the sample includes Ontario (Canada), England, Iceland, Norway, Poland, Singapore and Spain. The results demonstrate that the estimated patterns are clearly robust to using this sample. According to the linear probability regressions, the correlation of the cognitive effect and the school victimization effect amounts to -0.78 in this case.[8]

In addition to this check, Figure 2 also includes results from control function estimation generalizing the estimated effect to an average treatment effect under its functional form assumptions. The results are robust compared to the 2SLS estimation. As a further robustness check concerning functional form, Figure 2 also shows marginal effects from 'probit instrumental variable' (instead of linear probability) regressions for the binary outcome variable which again validates the results. The size of the estimated marginal effects is very close to the effects estimated via 2SLS.

[8] If a somewhat less strict criterion, say compliance corresponding to a first stage effect of 0.8 is used, the sample remains larger and includes a dozen of countries. The correlation of effects is -0.63 in this case.

It is beyond the scope of this paper to explain differences in the age effects in different countries in terms of institutional and policy characteristics. There is too much heterogeneity in education systems around the world and therefore it would be hard to pin down the relevant institutional effects interacting with age effects. However, note that Figure 2 implies that age effects in elementary school are highest in countries with so called ‘à la carte integration models’ (cf. the classification by Dupriez et al., 2008) like Canada and the United Kingdom. A la carte integration systems imply that primary education is generally comprehensive - there is a core curriculum common to all children - but grouping within elementary school classes may be based on the child’s ability.[9] Compared to these countries, countries with individualized teaching and integration systems like the northern European countries but also countries where children are prepared for being educated in different ability tracks (like in some central European countries) seem to deal better with the age effects within grades.

5 Conclusions

Based on pooled data for 17 countries, this paper presents evidence that children’s age within grade significantly affects standardized reading test scores (as measured at one point in time) as well as social outcomes. Older children within grades are less often victims of school violence. It is also shown that there is a negative correlation of cognitive and social effects. The presented results are robust to restricting the sample to countries with high compliance and to alternative estimation strategies. Sub-group analysis reveals that the age effects tend to be higher for boys than for girls. Analysis by immigrant background has to be taken with a grain of salt due to a reduced (possibly selective) sample but suggests that the age effects on school victimization are higher for children with an immigrant background compared to natives.

All in all, the paper demonstrates that age within grades matters for social outcomes. According to evidence from psychology (e.g. Cassidy, 2009) school victimization is a crucial determinant for children’s development of personality. Thus, it is very likely that being the youngest in class (and thus suffering from school victimization) also affects the children’s future non-cognitive outcomes.

[9] There might also be segregation for example by school districts in such systems.

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Tables

Table 1: Means of outcome and control variables by country

Country	Test score	Victimi-zation	"Things stolen"	"Being bullied"	"Being hurt"	Entry age	Male	Immigrant background	Obs. (All)
Austria	538.23	0.42	0.22	0.16	0.24	6.72	0.51	0.25	919
	(1.93)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	
Belgium (Flemish)	544.99	0.59	0.20	0.39	0.42	6.34	0.48	0.19	782
	(1.93)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	
Canada, British Columbia	558.16	0.55	0.30	0.29	0.29	6.30	0.49	0.55	648
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Canada, Nova Scotia	545.37	0.54	0.28	0.31	0.27	6.40	0.48	0.11	735
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	
Canada, Ontario	556.30	0.66	0.38	0.36	0.37	6.30	0.53	0.55	663
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Canada, Québec	528.42	0.54	0.31	0.26	0.30	6.48	0.50	0.21	619
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
England	540.35	0.59	0.25	0.32	0.41	5.52	0.51	0.24	674
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
France	521.92	0.58	0.35	0.33	0.32	6.35	0.52	0.29	721
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Iceland	510.10	0.44	0.15	0.30	0.22	6.21	0.48	0.16	551
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Italy	548.65	0.45	0.31	0.23	0.14	6.17	0.54	0.15	552
	(1.93)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	
Luxembourg	559.63	0.43	0.18	0.21	0.26	6.79	0.51	0.59	844
	(1.93)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Norway	495.59	0.34	0.13	0.16	0.20	6.24	0.47	0.15	635
	(1.93)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	
Poland	518.80	0.26	0.11	0.14	0.15	7.25	0.47	0.01	701
	(1.93)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.00)	
Scotland	531.96	0.52	0.19	0.31	0.34	5.23	0.45	0.13	544
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Singapore	553.74	0.60	0.36	0.34	0.29	6.55	0.49	0.34	1,045
	(1.93)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	
Slovakia	533.97	0.46	0.21	0.31	0.20	6.74	0.47	0.06	905
	(1.93)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	
South Africa	304.01	0.81	0.64	0.46	0.40	7.06	0.48	0.18	2,523
	(1.93)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	
Spain	513.97	0.60	0.31	0.22	0.44	6.31	0.54	0.17	702
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	
Sweden	545.74	0.31	0.14	0.11	0.19	7.32	0.54	0.25	725
	(1.93)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	
Taiwan	531.61	0.62	0.41	0.41	0.31	6.52	0.54	0.10	785
	(1.93)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	

Note: Standard errors in parentheses. Number of observations for test score sample is given in the last column. Samples restricted to students born one month prior to and after the school entry cut-off date as these samples are used for the regression analysis.
Source: PIRLS 2006. Own calculation.

Table 2: Documented school entry age rules for PIRLS countries

Country	Cut-off date	School year starting date	Age at cut-off date	Grade (year of observation)
Austria	September 1	September (beginning)	6	4
Belgium (Flemish)	December 31	September (beginning)	6	4
Canada, British Columbia	December 31	September (beginning)	6	4
Canada, Nova Scotia	October 1	September (beginning)	6	4
Canada, Ontario	December 31	September (beginning)	6	4
Canada, Québec	October 1	September (beginning)	6	4
England	August 31[A]	September (beginning)	5	5
France	December 31	September (beginning)	6	4
Iceland	December 31	August (end)	6	4
Italy	December 31	September (beginning / mid)	6	4
Luxembourg	September 1	September (mid)	6	5
Norway	December 31	August (mid)	6	4
Poland	December 31	September (beginning)	7	3
Scotland	August (mid)	August (mid)	5	5
Singapore	January 1	January (beginning)	6	4
Slovakia	September 1	September (end)	6	4
South Africa	December 31	January (beginning)	6	5
Spain	December 31	September (beginning / mid)	6	4
Sweden	December 31	August (mid)	7[B]	4
Taiwan	August (end)	August (end)	6	4

Note: [A] Several cut-off dates for first grade entry in England; promotion policy to following grades effectively yields August, 31 cut-off. [B] Entrance is also possible by the age of six in Sweden.
Source: PIRLS 2006. The sample is restricted to countries with verified rules and sufficient compliance with the rule. Own calculation.

Table 3: Means of main outcome variables by relative age for different sub-groups

Relative age	Test score				Any type of school victimization			
	Male	Female	Immigrant	Natives	Male	Female	Immigrant	Natives
-1.0	368.55	355.23	356.74	395.82	0.78	0.77	0.71	0.76
	(10.40)	(7.94)	(16.88)	(8.96)	(0.03)	(0.02)	(0.05)	(0.03)
-0.9	354.99	363.86	392.09	383.03	0.78	0.76	0.71	0.78
	(10.07)	(7.83)	(19.58)	(8.14)	(0.03)	(0.02)	(0.05)	(0.02)
-0.8	389.84	406.70	424.00	432.52	0.74	0.71	0.72	0.68
	(7.42)	(6.62)	(11.01)	(6.51)	(0.02)	(0.02)	(0.03)	(0.02)
-0.7	383.26	402.13	418.74	432.16	0.74	0.76	0.63	0.76
	(6.48)	(5.44)	(9.00)	(5.32)	(0.02)	(0.02)	(0.03)	(0.02)
-0.6	443.64	450.02	467.37	467.93	0.73	0.63	0.68	0.66
	(3.64)	(3.11)	(5.28)	(2.78)	(0.01)	(0.01)	(0.02)	(0.01)
-0.5	499.65	501.84	508.83	511.19	0.60	0.56	0.63	0.54
	(1.76)	(1.78)	(2.65)	(1.41)	(0.01)	(0.01)	(0.01)	(0.01)
-0.4	507.81	512.36	513.51	521.36	0.57	0.52	0.59	0.52
	(1.47)	(1.60)	(2.37)	(1.20)	(0.01)	(0.01)	(0.01)	(0.01)
-0.3	508.58	519.74	513.27	525.52	0.57	0.52	0.60	0.51
	(1.33)	(1.32)	(1.91)	(1.05)	(0.01)	(0.01)	(0.01)	(0.01)
-0.2	506.59	517.22	515.16	525.19	0.59	0.51	0.61	0.51
	(1.56)	(1.52)	(2.24)	(1.19)	(0.01)	(0.01)	(0.01)	(0.01)
-0.1	499.13	504.72	507.60	516.62	0.56	0.52	0.57	0.50
	(1.55)	(1.63)	(2.60)	(1.20)	(0.01)	(0.01)	(0.01)	(0.01)
0.0	514.04	526.58	517.87	531.25	0.55	0.51	0.59	0.50
	(1.42)	(1.49)	(2.19)	(1.14)	(0.01)	(0.01)	(0.01)	(0.01)
0.1	519.64	536.14	519.05	540.52	0.53	0.47	0.58	0.46
	(1.54)	(1.46)	(2.41)	(1.08)	(0.01)	(0.01)	(0.01)	(0.01)
0.2	517.29	529.54	522.50	534.13	0.55	0.47	0.59	0.48
	(1.42)	(1.34)	(1.88)	(1.09)	(0.01)	(0.01)	(0.01)	(0.01)
0.3	519.54	531.33	522.18	536.11	0.52	0.48	0.57	0.47
	(1.64)	(1.60)	(2.52)	(1.25)	(0.01)	(0.01)	(0.01)	(0.01)
0.4	496.55	513.02	493.58	522.80	0.53	0.47	0.62	0.46
	(2.12)	(2.07)	(3.54)	(1.57)	(0.01)	(0.01)	(0.01)	(0.01)
0.5	497.85	499.60	503.28	517.29	0.59	0.52	0.64	0.50
	(3.11)	(3.44)	(4.45)	(2.66)	(0.01)	(0.01)	(0.02)	(0.01)
0.6	397.90	420.11	454.00	430.13	0.63	0.65	0.56	0.65
	(6.21)	(5.86)	(6.63)	(5.45)	(0.02)	(0.02)	(0.03)	(0.02)
0.7	397.47	395.08	445.13	400.19	0.70	0.69	0.72	0.64
	(5.19)	(6.24)	(6.64)	(5.73)	(0.02)	(0.02)	(0.03)	(0.02)
0.8	373.40	376.88	455.43	377.47	0.68	0.70	0.74	0.65
	(6.94)	(7.02)	(7.76)	(6.97)	(0.02)	(0.03)	(0.03)	(0.03)
0.9	333.00	358.39	400.06	349.27	0.73	0.73	0.66	0.72
	(5.56)	(6.24)	(8.52)	(5.84)	(0.02)	(0.02)	(0.03)	(0.02)
1.0	390.51	428.47	425.46	428.79	0.68	0.60	0.59	0.67
	(8.10)	(8.80)	(11.38)	(8.49)	(0.03)	(0.03)	(0.04)	(0.03)
Obs.	46,997	46,925	18,343	61,578	45,937	45,984	18,237	61,238

Note: Standard errors in parentheses. Groups ranked by within country deviation from average age (measured in years).
Source: PIRLS 2006. Pooled sample of 17 countries. Restricted to age span +-1 year around average age within each country. Own calculation.

Table 4: 2SLS estimates of relative age on test scores and social outcomes (all countries)

	First stage	Second stage				
Sample	Relative age (in years)	Test score (in s.d.)	Victimization (probability)	"Things stolen" (probability)	"Being bullied" (probability)	"Being hurt" (probability)
All	0.81	0.27	-0.09	-0.06	-0.07	-0.04
	(0.01)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Male	0.81	0.31	-0.12	-0.10	-0.11	-0.06
	(0.02)	(0.06)	(0.02)	(0.02)	(0.02)	(0.02)
Female	0.80	0.23	-0.06	-0.02	-0.03	-0.03
	(0.02)	(0.05)	(0.03)	(0.02)	(0.02)	(0.02)
Immigrants	0.74	0.27	-0.15	-0.11	-0.06	-0.09
	(0.04)	(0.10)	(0.05)	(0.05)	(0.04)	(0.04)
Natives	0.83	0.28	-0.08	-0.04	-0.08	-0.04
	(0.02)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)
Obs. (all)	16,244	16,244	15,866	15,816	15,722	15,740

Note: Standard errors in parentheses. Relative age defined as within country deviation from average age (measured in years).
Source: PIRLS 2006. Pooled sample of 17 countries. Restricted to age span +-1 year around average age within each country. Own calculation.

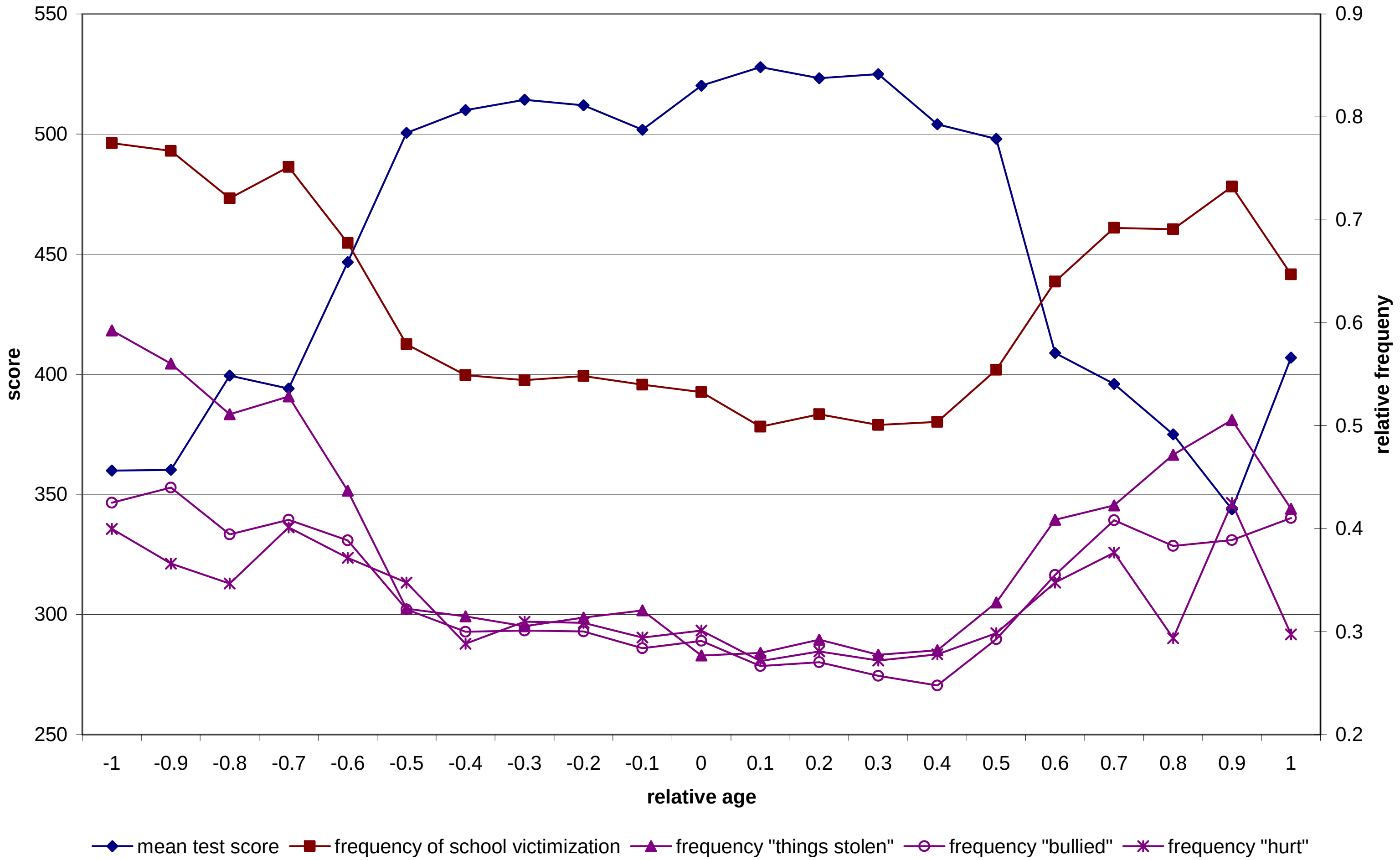
Table 5: 2SLS estimates of age effects on test scores and social outcomes by country

Country /coefficients (s.e.)	First stage	Test score (in s.d.)	Victimization (general)	“Things stolen”	“Being bullied”	“Being hurt”
Scotland	0.66	0.49	-0.17	-0.02	-0.13	-0.01
	(0.05)	(0.15)	(0.08)	(0.07)	(0.08)	(0.08)
England	0.92	0.41	-0.13	-0.02	-0.11	-0.07
	(0.02)	(0.08)	(0.05)	(0.04)	(0.04)	(0.04)
Slovakia	0.52	0.38	0.00	0.00	-0.02	0.07
	(0.04)	(0.12)	(0.09)	(0.07)	(0.07)	(0.07)
Canada, Québec	0.81	0.35	-0.10	-0.05	-0.03	-0.08
	(0.04)	(0.08)	(0.07)	(0.07)	(0.06)	(0.06)
Canada, Ontario	0.89	0.32	-0.18	-0.11	-0.08	-0.09
	(0.03)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)
Spain	0.90	0.32	-0.11	-0.09	-0.02	-0.14
	(0.03)	(0.07)	(0.05)	(0.05)	(0.05)	(0.06)
Canada, British Columbia	0.84	0.28	-0.02	-0.03	-0.08	-0.06
	(0.03)	(0.07)	(0.06)	(0.06)	(0.05)	(0.05)
Iceland	0.98	0.28	-0.04	0.04	-0.06	-0.07
	(0.01)	(0.06)	(0.04)	(0.03)	(0.04)	(0.04)
France	0.84	0.25	-0.11	-0.11	-0.11	-0.04
	(0.04)	(0.07)	(0.05)	(0.05)	(0.05)	(0.05)
Taiwan	0.84	0.25	-0.10	-0.03	-0.18	-0.12
	(0.02)	(0.06)	(0.05)	(0.05)	(0.05)	(0.04)
Italy	0.73	0.25	-0.04	-0.08	-0.09	0.08
	(0.05)	(0.09)	(0.06)	(0.06)	(0.06)	(0.04)
Sweden	0.83	0.22	-0.07	-0.06	-0.02	0.00
	(0.04)	(0.07)	(0.05)	(0.04)	(0.04)	(0.04)
Norway	0.96	0.22	-0.04	0.00	-0.02	-0.01
	(0.01)	(0.08)	(0.05)	(0.04)	(0.05)	(0.05)
Poland	0.96	0.21	-0.02	0.01	-0.03	0.01
	(0.02)	(0.09)	(0.04)	(0.03)	(0.03)	(0.03)
Canada, Nova Scotia	0.76	0.21	-0.01	-0.06	0.01	-0.01
	(0.03)	(0.08)	(0.06)	(0.06)	(0.05)	(0.05)
Belgium (Flemish)	0.67	0.19	-0.08	-0.03	-0.11	-0.07
	(0.04)	(0.07)	(0.06)	(0.05)	(0.07)	(0.06)
Luxembourg	0.66	0.17	-0.07	-0.01	-0.02	-0.08
	(0.05)	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)
Austria	0.50	0.14	-0.06	-0.04	-0.01	-0.03
	(0.04)	(0.10)	(0.07)	(0.07)	(0.06)	(0.06)
Singapore	0.97	0.10	-0.02	0.00	-0.07*	0.01
	(0.02)	(0.06)	(0.04)	(0.03)	(0.04)	(0.04)
South Africa	0.66	0.01	-0.05	-0.04	0.01	-0.01
	(0.05)	(0.13)	(0.03)	(0.04)	(0.04)	(0.04)

Note: Countries ordered by size of age effect on reading test scores.
Source: PIRLS 2006. Own calculation.

Figures

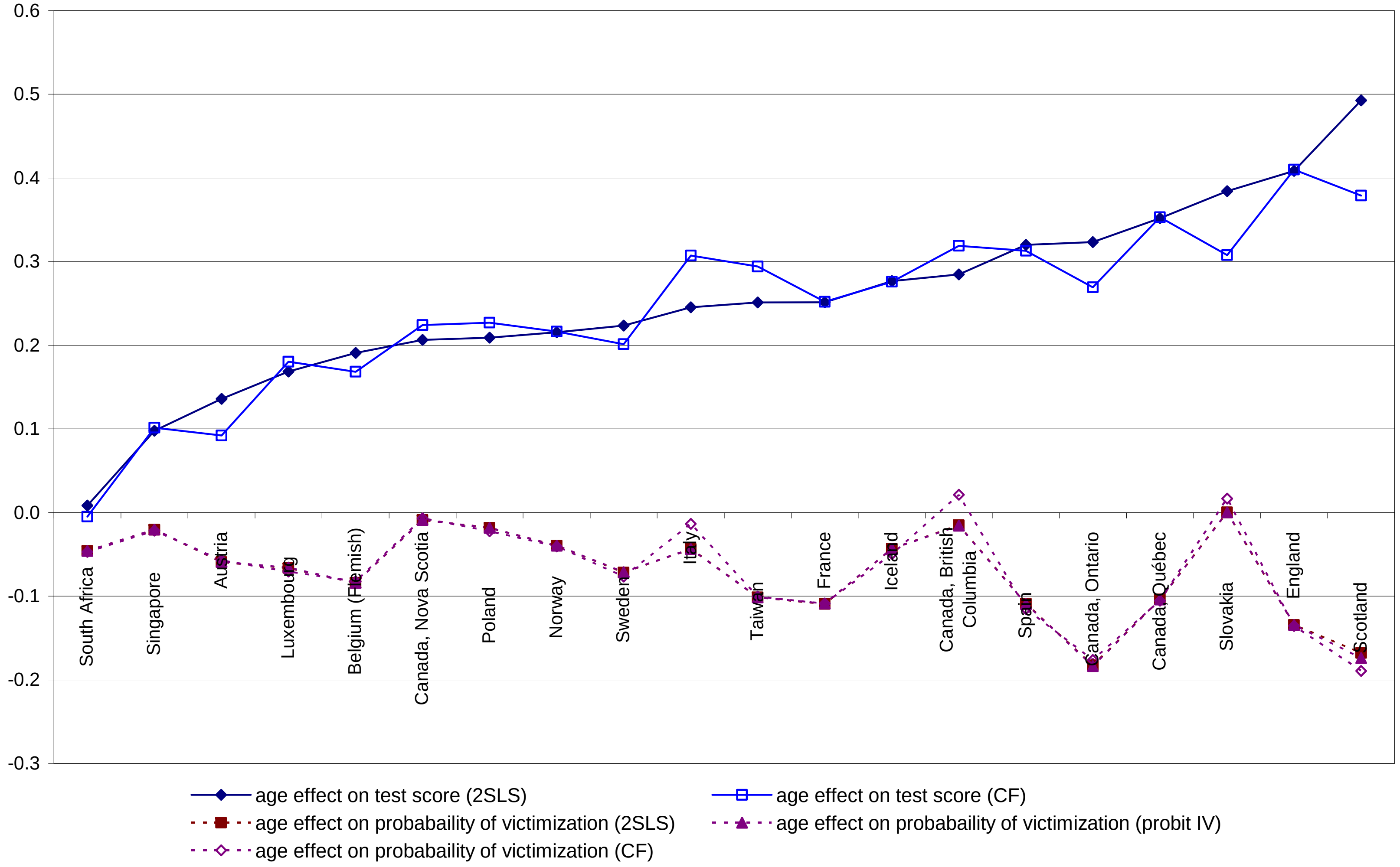
Figure 1: Means of outcome variables by relative age (pooled sample of all countries)



Note: Relative age indicates within country deviation from average age (measured in years). Table 3 includes detailed means for sub-groups.

Source: PIRLS 2006. Pooled sample of 17 countries. Restricted to age span +-1 year around average age within each country. Own calculation.

Figure 2: Robustness of IV and control function estimates of age effects by country



Note: Countries ordered by size of age effect on reading test scores.

Source: PIRLS 2006. Own calculation.