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Teaching Practices and the Persistence of School-Entry Age Effects

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ABSTRACT

We consider the effect of teaching practices on the persistence of school-entry age effects caused by rigid cutoff dates for school eligibility in Spain. We document significant school-entry age effects for the same cohort of students when they were in elementary and secondary school. Then, we test whether school-entry age effects at age 15 are lower for those students who were more frequently exposed in elementary school to modern teaching practices, grounded in active and cooperative learning. We find that the relationship between teaching practices and age effects is non-linear. Extreme bias toward any practice, modern or traditional, by elementary teachers exacerbates age effects. Conversely, age effects are mitigated when elementary teachers follow a balanced approach that combines different teaching styles.

JEL Classification: I21, I24, J24.

Keywords: School-entry age effects, teaching practices.

1. Introduction.

Nearly all education systems have a single annual cutoff date for school eligibility. This, in turn, causes some students to be almost one year older than others when they begin school. The international evidence agrees that these initial maturity differences have long-lasting effects on education. Relatively older students perform better during compulsory education, accumulate more human capital, and are less likely to be diagnosed with learning disorders than their younger classmates (Bedard and Dhuey 2006, Elder and Lubotsky 2009). School starting age also affects relevant economic outcomes outside of the classroom, like prime-age earnings (Fredriksson and Öckert 2013), criminal behavior (Cook and Kang 2016), and intergenerational educational mobility (Bauer and Riphahn 2009).

Students' non-cognitive skills are thought to play a crucial role in the propagation of school-entry age effects. Mühlenweg et al. (2012) find that German children entering school at a relatively younger age because of school entry regulations are less persistent than their older classmates, even at age eleven, with no relevant differences in cognitive skills. Givord (2021) finds, using data from the Program for International School Assessment (PISA) for six European countries, including Spain, that students who enter school relatively younger have more negative relationships with teachers and peers, lower intrinsic motivation and self-esteem, and less ambitious educational expectations than peers who enter school older. These findings suggest that initial maturity gaps may affect children's non-cognitive skills like academic self-concept and, thus, their motivation to learn can be durably undermined. That might well be the case since skills accumulated in early childhood are complementary to later learning (Cuhna et al. 2006).

In this paper, we consider whether elementary school teachers' choices about how to allocate time across different instructional activities affect the long-run propagation of early maturity gaps. In particular, we analyze whether school-entry age effects in secondary school are lower for students who had more exposure to the often termed "modern" style teaching practices, grounded in active and cooperative learning, in elementary education.

We formulated this hypothesis based on available evidence about the effect of teaching practices on both students' non-cognitive skills and the gender math gap. First, Flèche (2017) shows, using a UK birth longitudinal study, that teaching practices play a crucial role in explaining variations in elementary teachers' ability to improve students'

cognitive and non-cognitive skills. She finds that only modern teaching practices are positively correlated with teachers' ability to increase students' non-cognitive skills, which, in turn, raises long-run outcomes such as higher education attendance, earnings, unemployment, and full-time employment, and subsequent test scores and non-cognitive skills. Additionally, Algan et al. (2013) show that modern instruction methods are conducive to the formation of social capital, whereas traditional methods like lecturing or having students work individually are not. This can also be particularly beneficial for the younger students in a cohort, given the evidence on their lower endowment of social skills.

In a related and recent contribution, Di Tommaso et al. (2024) find that an intervention grounded in active and cooperative learning practices improved girls' math performance, with no impact on boys, reducing the gender gap among Italian elementary students by about 40%. The intuition behind this result is that modern teaching provides a cooperative and non-competitive learning environment that might be particularly beneficial for less motivated or less competitive students, like girls in math or the younger students in a cohort. As argued in O'Connor and Bartolini (2025), modern teaching practices like group discussion provide all students with a supervised and psychologically safe environment to socialize and communicate. Such an environment is likely to enhance the benefits of having older classmates for the younger ones in a cohort (Elder and Lubotsky 2009).

To study the effects of different types of elementary school teachers' practices on the persistence of school-entry age gaps in secondary school, we combine data from the 2009 General Diagnostic Assessment (GDA), conducted by the Spanish Ministry of Education, and the 2015 PISA edition for Spain, allowing us to assess fourth and tenth graders' competencies, respectively. Both datasets inform about 1999-born students' self-reported age at school entry, family environment, performance, and non-cognitive skills. We estimate the effect of school-entry age by instrumenting the reported age at school entry with the "expected" age at enrollment as defined by the strict application of regulations for school enrollment.

The GDA data also informs about elementary teachers' allocation of class time across nine different instructional activities. We then use this data to estimate indicators of predominant elementary school teaching practices for each combination of students' region of residence (17 categories) and urbanicity in which the elementary school is

located (5 categories). The estimated indicators are then combined with the PISA sample using region of residence and urbanicity as the merging variables. The validity of our approach rests on the low geographical mobility of Spanish families with children. According to the 2011 Spanish Population Census, 91% of the households with at least one child aged 14-15 years old live in the same region and community, or a community of the same level of urbanicity, as they did a decade ago, when the child was about to start school.

The case of Spain is interesting for several reasons. First, families are generally not allowed to postpone or anticipate entrance to elementary school. This, in turn, ensures the monotonicity of our instrument, providing a clean identification (Barua and Lang 2016). Second, in Spain, there is no tracking until the end of lower secondary, and, thus, the selection of students across different tracks, and the role of initial school-entry age effects in that selection, cannot contaminate our estimates. Third, the estimated school-entry age effect for Spain is among the highest across European countries (Bedard and Dhuey 2006). Finally, Spanish regions all operate under the same national legal framework regulating the principles, objectives, evaluation criteria, organization of the different school levels, and up to 65% of the contents and subjects studied. Thus, differences in curriculum across regions are also unlikely to contaminate our results, either.

Our estimates show lasting school-entry age effects, in 10^{th} grade, for 15-year-old students' test scores, grade repetition, expectations for tertiary education, and non-cognitive skills like test anxiety, academic ambition, and cooperative problem-solving skills. While estimated age effects on test scores are lower by at least 60% between grades four and ten, they still amount to 0.1σ in math and reading at age 15. College-educated parents can partially buffer the negative effect of their child being relatively younger on the child's outcomes.

We find that the relationship between teaching practices in elementary school and school-entry age effects at age 15 is nonlinear. It appears that what is important is the frequency with which elementary teachers use a specific teaching practice in the classroom. For instance, traditional teaching practices like lecturing or having students work individually are effective at compensating for school-entry age gaps as long as elementary school teachers don't use these techniques during most or all of their class time, but only sometimes. Similarly, modern teaching practices like having students

work in small groups or making presentations are also able to reduce school-entry age effects on performance and educational expectations if elementary school teachers use them only sometimes. However, the buffering effect of having students work in small groups on students' academic ambition and grade repetition is only achieved if these techniques are used more intensively, although still not exclusively (almost always) used. Therefore, it appears that extreme use of any teaching practice in elementary school, no matter whether it is modern or traditional, is likely to exacerbate school-entry age effects. Conversely, school-entry age effects are totally or partially mitigated when elementary teachers follow a more balanced approach that combines different teaching styles.

We contribute to the research on the effect of different types of teaching practices. Our results align with those of Algan et al. (2013), who find that using solely either modern or traditional teaching practices is detrimental to eighth graders' performance in OECD countries, and that the relationship between teaching practices and performance is nonlinear. Similarly, using panel data for Israel, Lavy (2016) also finds that both traditional and modern instructional activities have a positive effect on test scores and do not necessarily crowd out each other. Along these lines, Bietenbeck (2014) finds, using cross-country data for eighth graders, that while traditional teaching practices improve knowledge and reasoning skills, modern teaching practices improve reasoning skills. Burgess et al. (2022) find, using data from secondary schools in England, that teaching methods predict performance independently of the quality of the teacher's instruction. To the best of our knowledge, ours is the first paper that analyzes the effect of teaching practices on the inequality caused by the rigid cutoff dates for school entry.

The rest of the paper is organized as follows. Sections 2 and 3 describe the Spanish education system and the data used in the estimation, respectively. Section 4 outlines the identification strategy. Sections 5 and 6 analyze the validity of the instrument and discuss our main results. Finally, we present our conclusions in Section 7.

2. Compulsory Schooling in Spain.

Spanish children must begin school during the calendar year of their 6^{th} birthday, which implies that the school entry cutoff date is January 1. The enrollment rule is quite strict, and more than 99% of children enrolled in elementary education at six years old.

Elementary education lasts six years, followed by four years of lower secondary education. Students are required to stay in school until they turn 16. After successfully completing lower secondary education, students can enroll in either vocational or academic-focused upper secondary education. Despite this tracking, ability grouping is not a common practice in Spain.

Spanish students can only be retained once during their elementary school education. Students who do not make sufficient academic progress in the first two grades of lower secondary can be retained in both of these grades. In this respect, Spain stands out among developed countries for both its high levels of grade retention in secondary education and its high early-dropout rates, i.e. students leaving without completing compulsory secondary education. The Spanish early-dropout rate has been among the highest in the last decades, ranging from 25% in 2012 to 14% in 2022. The corresponding numbers for the European Union average were 12% and 9%, respectively. Grade retention in Spain more than doubles that of the OECD average in PISA 2015.

Spanish Autonomous Communities (hereinafter, *regions*) have been fully responsible for the management of educational resources since 2000. Spanish regions all operate under the same national legal framework regulating the principles, objectives, evaluation criteria, organization of the different school levels, and up to 65% of the contents and subjects studied. The share of instructional time devoted to mathematics instruction in elementary school varies by region, ranging from 15% to 19%. The corresponding percentage for language and reading instruction is 25%, but in some regions Spanish language is substituted or complemented by local languages like Catalan, Galician, Basque, and Valencian languages.

3. Data.

We use data from the 2009 General Diagnostic Assessment (GDA), conducted by the Spanish Ministry of Education, and the 2015 edition of the Program for International Student Assessment (PISA) for Spain.[1] GDA 2009 and PISA 2015 are representative of the Spanish population of fourth graders and 15-year-old students at both the national and regional levels.

We use these datasets to obtain information about 1999-born students' age at school entry, family environment, and in-school performance. We also use these datasets

[1] The GDA assesses the competences of fourth graders using a standardized test following PISA's methodology.

to study information about students' non-cognitive skills. In this respect, while the GDA 2009 only informs about the quality of the student's relationship with classmates, PISA 2015 provides information on multiple other related measures, including test anxiety, academic ambition, and collaborative problem-solving skills. The Collaborative Problem-Solving assessment, carried out as part of PISA 2015, measures students' capacity to effectively engage in a process whereby two or more students attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills, and efforts to reach that solution. This, in turn, requires adequate levels of communication, conflict management, planning, and organization skills, the skills required in workplace and civic settings.

Regarding teaching practices, the GDA 2009 asks teachers to rate how much they agree with each of these sentences: a) "I lecture most of the time"; b) "Students make presentations"; c) "I pose questions to students while I am lecturing"; d) "Students ask me their doubts while I am lecturing"; e) "I promote open discussion among students"; f) "I assign class work to students"; g) "Students work individually"; h) "Students work in small groups"; i) "I adapt activities to students with learning difficulties". The answers range from 1 to 4, with 1 representing Never or almost never, 2 Sometimes, 3 Almost Always, and 4 Always. The same questions were posed to students.[2] Following the taxonomy of class practices in Zemelman et al. (2012), instructional activities a), f), and g), described above, can be classified as traditional practices in which the teacher assumes a central role as the disseminator of learning and the orchestrator of classroom activities. Conversely, activities b), e), and h) are classified as modern practices in which students have a more active role in the learning process. As argued in Hidalgo-Cabrillana and Lopez-Mayan (2018), the wording of options c), d), and i) does not allow us to unambiguously classify them as modern or traditional activities.

We use GDA 2009 data to estimate indicators of predominant teaching practices during elementary school for each combination of region (17 categories) and urbanicity in which the elementary school is located (5 categories). The estimated indicators are then merged with the sample of students in PISA using the students' region of residence

[2] Hidalgo-Cabrillana and Lopez-Mayan (2018) use GDA 2009 data to analyze the effect of teaching practices on students' performance. They find different and sometimes contrasting results depending on whether they use teachers or students as the source to classify teaching practices. Remarkably, our results are robust to the source considered. Our main results are obtained using teachers' responses since the estimation sample is larger.

and urbanicity as the merging variables.[3]

Figure 1 uses PISA 2015 data to illustrate the distribution of (unconditional) school-entry age effects, at age 15, in reading and math across those OECD countries that have a national strict cutoff date to enroll children in school. Across many countries, we observe that students born in the month preceding the national cutoff date perform worse in both reading and math than students born just after the cutoff. Spain stands out as the country with the largest school-entry age effects in math and reading at age 15. In Spain, the school-entry age gap in math and reading amounts to 21% and 26% of a standard deviation of student performance, respectively.[4]

Figure 1. School-entry age gaps in reading and math. OECD countries. PISA 2015.

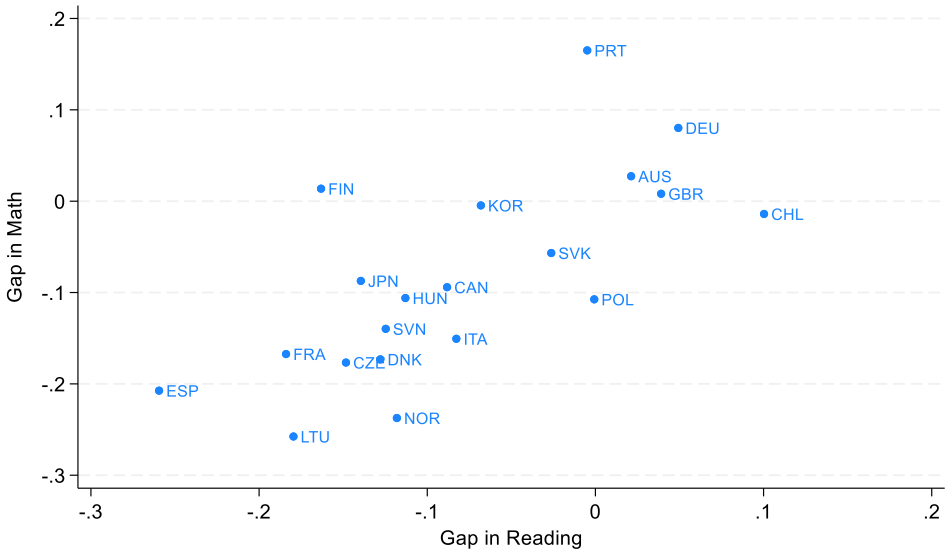


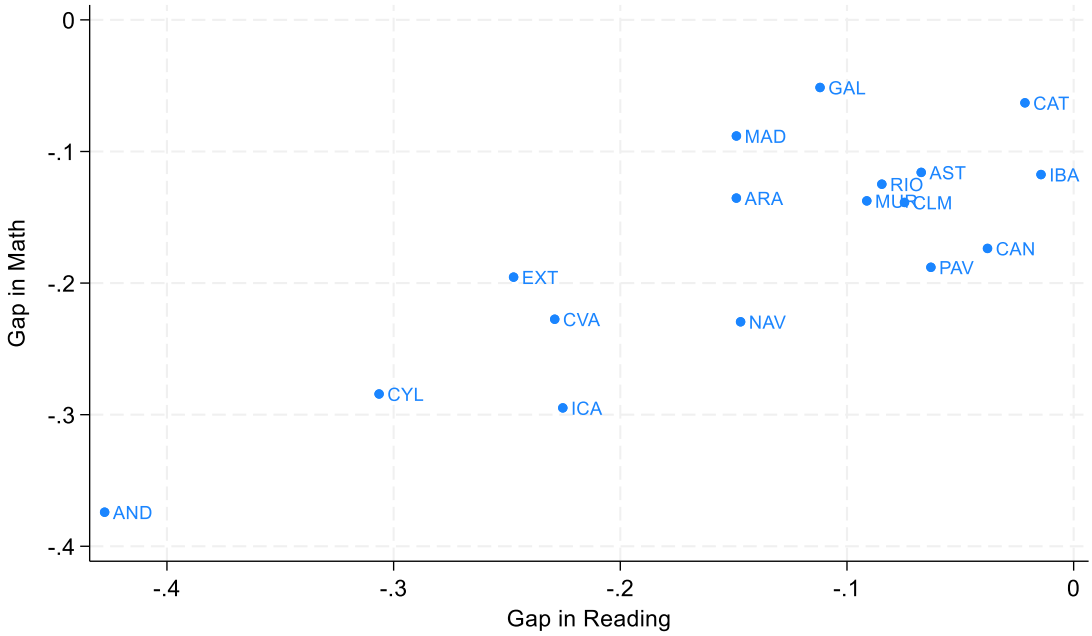
Figure 2 illustrates the distribution of unconditional school-entry age gaps across Spanish regions in PISA 2015. The dispersion in the distribution of school-entry age effects is larger across Spanish regions than across OECD countries represented in Figure 1. The reading and math school-entry age gaps for Andalusian students, the region with the largest effects, are seven times larger than those for students living in

[3] While both GDA 2009 and PISA 2015 use five categories to classify the urbanicity of the community in which the school is located, those categories are not the same. In GDA 2009, communities are classified as: rural (less than 2.000 people), small town (2.000-10.000 people), town (10.000-50.000 people), city (50.000-500.000 people), and large city (more than 500.000 people). In PISA 2015, the options are: rural (less than 3.000 people), small town (3.000-15.000 people), town (15.000-100.000 people), city (100.000-1.000.000 people), and large city (more than 1.000.000 people). Own estimations using the continuous version of the Spanish Padron of population show that this discrepancy affects only about 15% of the Spanish total population, mainly those people living in communities with 50.000 to 100.000 people.

[4] To put the size of these estimates into perspective, 30% of a standard deviation is equivalent to the competences usually learnt during a whole school year.

Asturias and Cantabria, regions with the lowest age effects.

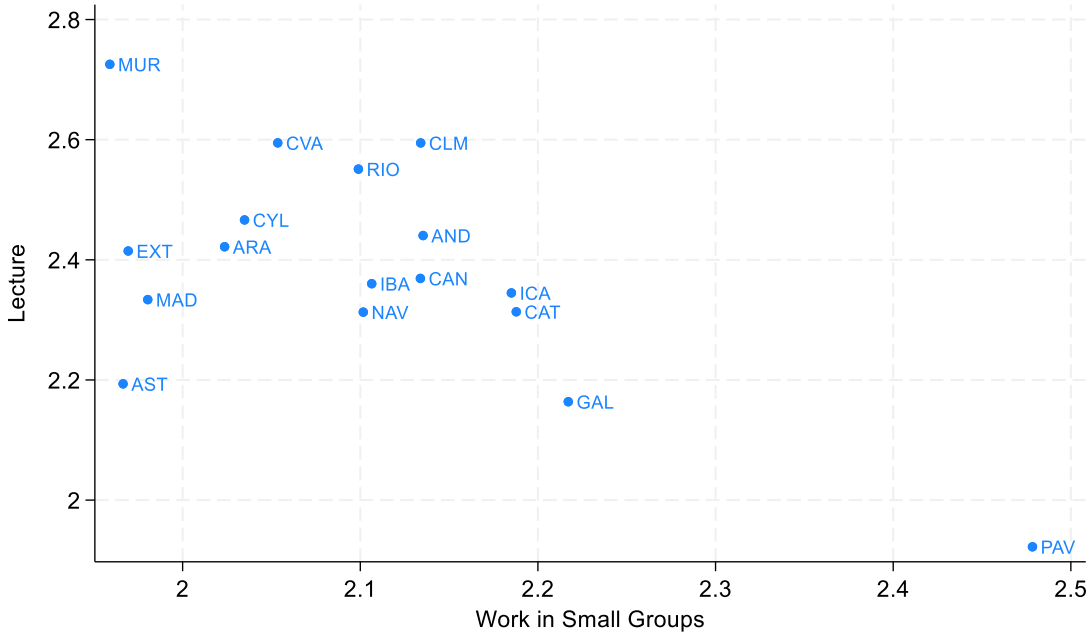
Figure 2. School-entry age gaps in reading and math. Spanish regions. PISA 2015.



Next, we use GDA 2009 data to show that teaching elementary education methods differ tremendously across Spanish regions. Figure 3 shows a negative cross-region correlation between the share of elementary school teachers who report "lecturing most of the time" and having "students work in small groups" most of the time, as the most frequently used examples of traditional and modern teaching practices, respectively. The coefficient of correlation equals -0.64.[5] The share of teachers who report lecturing most of the time is lowest in Spain's northern regions, like Galicia, the Basque Country, and Asturias. This is also the case in the regions of Catalunya and Madrid. Conversely, lecturing is particularly frequent in Spain's Southern regions, like Murcia and Valencia, as well as the two Castiles.[6]

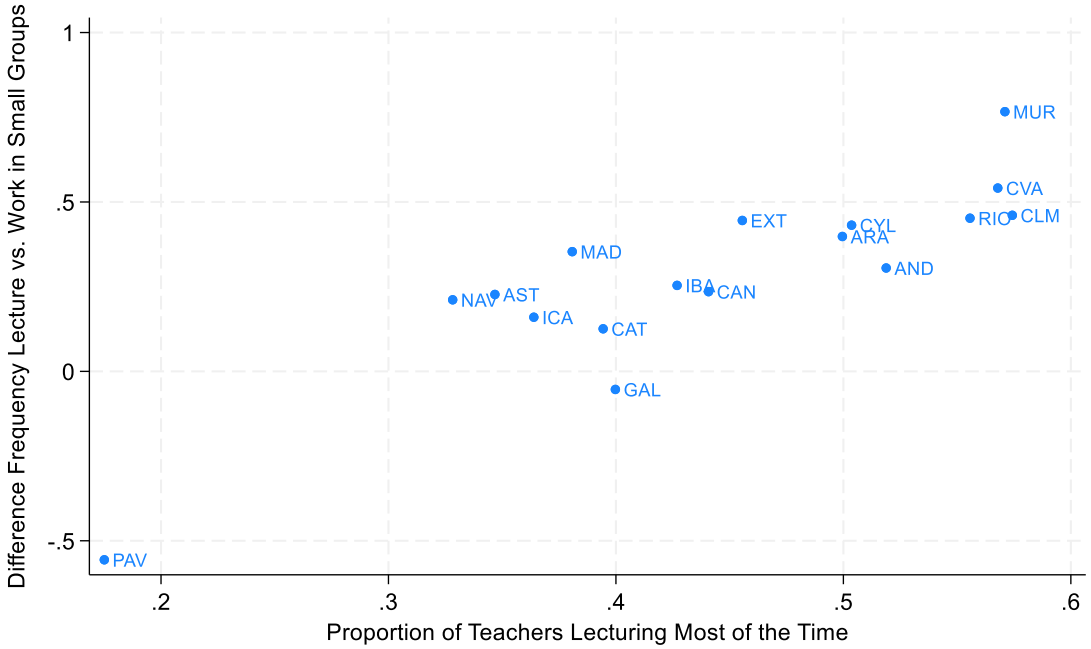
[5] Algan et al. (2013) find a cross-country correlation of -0.42 between the indicators "teacher lectures" and "students work in small groups" in grades 8 and 9 across 25 countries.
[6] We reach identical results when we use the first principal components indexes of teaching practices for traditional and modern instruction activities.

Figure 3. Elementary teachers lecturing and having students work in small groups most of the time. Spanish regions.



Following Algan et al. (2013), in Figure 4 we illustrate the extent to which a region tilts toward traditional rather than modern teaching by comparing, on the one hand, the difference between the frequency with which teachers in the region lecture and having students work in small groups and, on the other hand, the share of teachers who report that they always or almost always lecture. The cross-region correlation between these two indexes is 0.87. While Nordic regions like Galicia, Basque Country, and Catalunya exhibit a low gap between the two practices, elementary school teachers in Southern regions like Murcia and Valencia lecture students much more frequently than they ask them to work in small groups.

Figure 4. Gap between the frequency with which teachers lecture and have students work in small groups, and the regional share of teachers who lecture most of the time



Finally, Table 1 provides a summarized description of the data at hand. Overall, the GDA 2009 and PISA 2015 are relatively similar in composition, as it is expected, as they both represent the same cohort of students when they were in 4th and 10th grade. In both samples, students report that they started compulsory education at the age of 5 (61 months and 63 months, respectively). Between 10 and 14% of the students in each sample are born to an immigrant father or mother. 30 to 32% of students report having a mother who graduated from college, while 23 to 25% come from households with high Socioeconomic Status (SES). Most students in both samples live in communities with between 10,000 and 50,000 inhabitants, or with between 50,000 and 50,000 inhabitants.

4. Empirical Strategy.

We propose the following regression model to analyze the effect of age at school entry:

$$y_{ij} = \alpha_0 + \beta_0 X_i + \gamma A_{ij} + \eta_j + \varepsilon_{ij} \quad (1)$$

where y_{ij} is a measure of performance, expectations for educational attainment, or non-cognitive skills of student *i* living in region *j*, X_i is a vector of predetermined student and family characteristics like students' gender, family immigration status, and parental education, A_{ij} is self-reported age at primary school entry and η_j represents region-fixed

effects.

To facilitate comparability at the country and regional levels, we normalize most variables of interest so that their mean is zero and their standard deviation is one in each region. We only use the first plausible value for any subject assessed in GDA and PISA.

Our coefficient of interest is γ and captures the effect of school-entry age on students' outcomes. The main concern in obtaining a causal estimate of γ is that decisions to postpone or advance school entry could be endogenous and depend on the child's maturity at the time of school entry. While Spanish families are not generally allowed to postpone or advance entrance to school, there could be some exceptions leading to potential endogeneity. Another potential source of endogeneity would be measurement error in the students' reported school-entry age. In both these cases, we expect the OLS estimate of γ in (1), to be likely to underestimate the effect of age at school entry on performance.

To address the potential endogeneity of A_i we instrument the students' reported age at school entry with the "expected" age at enrollment as defined by the strict application of regulations for school enrollment. Thus, in the first step of this two-stage instrumental variable approach, we estimate the following equation:

$$A_{ij} = \alpha_1 + \beta_1 X_i + \delta EA_i + \eta_j + \upsilon_{ij} \qquad (2)$$

where EA_i is the expected age (in months) at which student *i* should have started school according to regulations. The identification assumption underlying this approach is that the "expected" age at entry is uncorrelated with unobserved characteristics that affect y_i. This assumption would fail, for instance, if parents who are more concerned about their child's performance target the weeks just after the cutoff date to give birth. In the next section, however, we provide evidence against the plausibility of this hypothesis.

Next, we expand equations (1) and (2) to further control for predominant teaching practices in elementary schools in the region and urbanicity level where the PISA student lives. In particular, we include interaction terms of elementary school teaching practices measured with the GDA data with reported and expected age at school entry, to study whether school-entry age effects depend on predominant elementary school teaching practices. When doing so, we cluster the standard errors at the region and urbanicity levels. The coefficients of interest are now those for the interactions between age at school

entry and the corresponding indicators of elementary school teaching practices, while controlling for resources at the regional and urbanicity levels.

This expanded version of equations (1) and (2), including elementary school teaching practices at the region and urbanicity level, is analogous to a reduced form regression in an instrumental variables approach, where region-urbanicity level teaching practices and resources are used as the excluded instruments for the actual classroom teaching practices and resources a student experienced.[7] This, in turn, means that any idiosyncratic student/teacher characteristics, observed or unobserved, are not likely to cause any endogeneity in teacher practices and resources at the region-urbanicity level of aggregation. Conversely, factors common to students at the regional-urbanicity level could be a problem for isolating the effect of just teaching practices. To address this concern, we use GDA data to estimate additional controls for elementary school teacher quality, like average teacher education and experience at each region-urbanicity level, and for regional development, like the share of families located in the top quarter or between the median and percentile 75 of the regional distribution of socioeconomic status.

5. Validity of the Instrument.

The major concern in obtaining a causal estimate of γ by using the instrumental variables approach described in section 4 above, is the possibility that expected school-entry age might be correlated with unobserved characteristics determining the outcomes. That could happen, for example, if parents who are concerned with the a priori negative consequences of being the youngest in the classroom, time pregnancy to give birth after the birthday cutoff. For instance, Elder and Lubotsky (2009) document that the kindergarten entrance age has steadily increased in the United States in the last decades due to policy reforms and parental choices based on the conventional wisdom that children who are older when they start kindergarten do better in school.

The hypothetical self-selection of families before or after the birthday cutoff would bias our estimates if parents sort according to dimensions not captured in our controls and related to the potential outcomes. However, this does not seem to be a concern for the case of Spain, as previous research has largely rejected the self-selection

[7] The indicators of teaching practices at the region-urbanicity level are highly significant determinants of classroom teaching practices in grade four at the classroom or school levels.

hypothesis. Calsamiglia and Loviglio (2020) find, using data from public schools in Catalonia, that students are equally likely to be born at the beginning or the end of the year and that predetermined controls like parental education are continuously distributed around the cutoff date. Additionally, they also reject the hypothesis that birth seasonality could be an issue. Equivalent results are obtained in Berniell and Estrada (2020) for a pool sample of 2003-2012 PISA students enrolled in both public and private schools in Spain.

For our estimation samples, Figure 5 shows the distribution of the average number of births by month. Like prior research described above, we do not find any suspected jump in the number of births around the birthday cutoff for children born in 1999. Figure 6 shows the distribution of the average number of births per month but focusing on mothers with a confirmed that maternal education is also balanced around the cutoff in our estimation samples. Comparing both figures we see that there are only minor discrepancies in birth dates between more and less educated mothers in our samples. If anything, it appears that more educated mothers are slightly overrepresented among those giving birth in December. Overall, both the prior literature and our data show no indication of strategic birth timing that would invalidate our instrumental variable approach.

Figure 5. Average number of births per month in GDA and PISA.

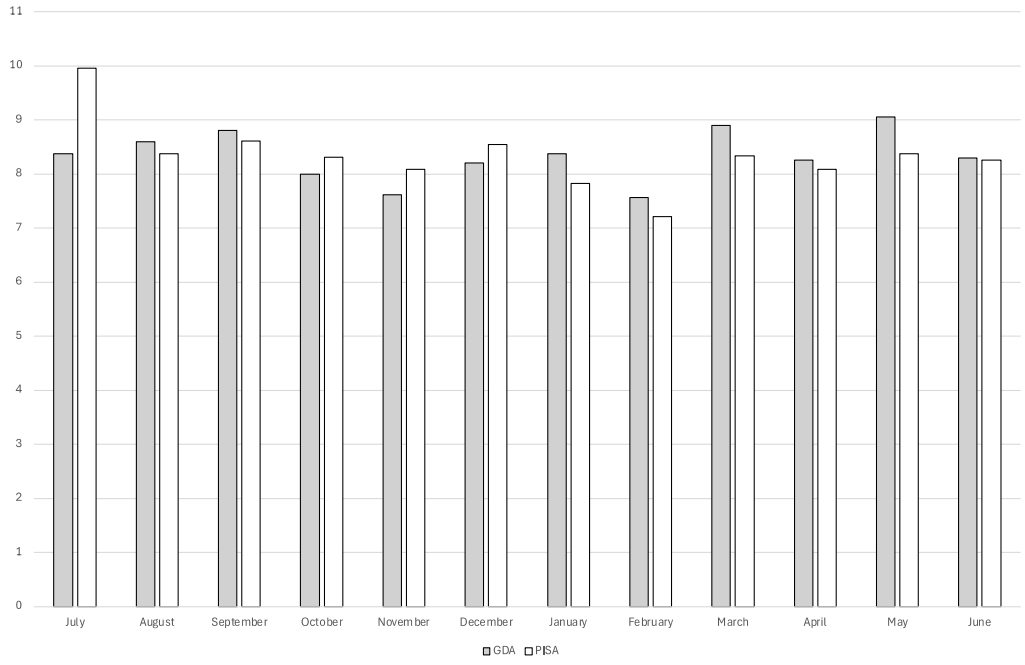
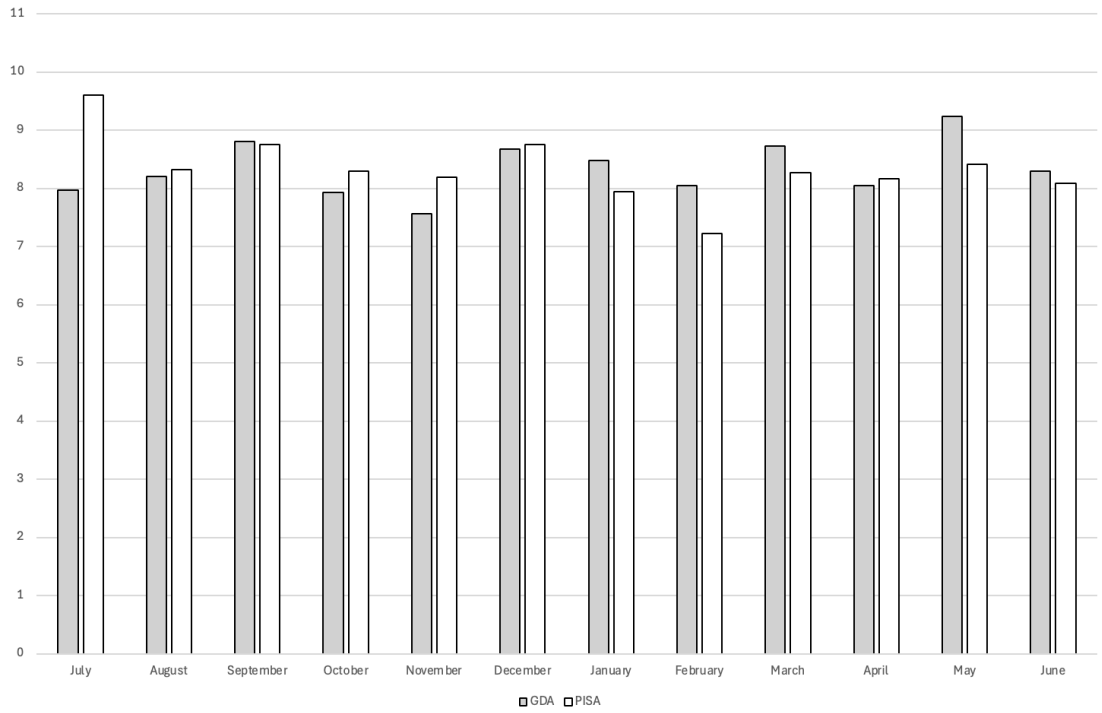


Figure 6. Average number of births per month in GDA and PISA, Among Mothers with Postsecondary Education .



6. Results.

6.1. School- Entry Age Effects in Grade 4.

Table 2 presents our estimates for the effect of school-entrance age on fourth graders' performance in the subjects assessed in GDA 2009: Spanish language, mathematics, sciences, and social sciences. Our results confirm that OLS estimates are downward biased, and that school-entry age has a positive and relevant effect on fourth graders' performance. A one standard deviation increase in entrance age accounts for between 0.21 and 0.23 of a standard deviation (σ) in fourth graders' test scores.

Following a similar approach to ours, Bedard and Dhuey (2006) find that the effect of entrance age on fourth graders' math performance ranges from 0.20σ to 0.26σ in a sample of European countries, not including Spain. This, in turn, suggests that the estimated school-entry age effect for Spain is in line with what is observed across other European countries.

Table 3 presents the first step of the IV estimation. As expected, the reported age at school entry is strongly related to the expected age at enrollment, based on the strict application of regulations for school enrollment, with almost a one-on-one relationship.

The estimated F-statistic of over 200 allows us to reject the hypothesis of weak instruments and under-identification.

Table 4 presents the results of the school-entry age effects and student performance for grade 4 students using alternative specifications. Our baseline specification controls for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. Next, we further control for the student socio-economic status (SES), replicating the estimates in Table 2. Then, we add a control for whether the student is attending a private school, as well as present separate estimates for students in public and private schools. We find that school-entry age effects remain stable across specifications. Indeed, the effect remains largely unaffected when we further control for whether the school is public or private, and for parental socioeconomic and cultural relative position in the region. We also find that school-entry age effects in 4th grade are not significantly different for students enrolled in public and private schools.[8]

We also study whether school-entry age affects students' and their parents' expectations of the child's educational attainment. The GDA survey asks students' parents to report whether they expect their child to complete lower secondary, vocational training, upper secondary, or a university degree. Students are also offered the option "I have not decided yet", since they are 9 years old when they take the survey. The estimates in Table 5 show that school-entry age has a sizeable positive impact on both children's and their parents' expectations of the child's educational attainment. The marginal effect of a one standard deviation increase in school-entry age amounts to increasing fourth graders' expectations for completing tertiary education by 1.5 percentage points (0.26σ). The corresponding effect on parental expectations is 0.9 percentage points (0.20σ). These results are not driven by the effect of age at school-entry on performance, since our estimates include students' test scores in reading as a control variable.

Table 5 also shows the results of school-entry age on the probability of a student being held back. In this case, we also find that school-entry age lowers the probability

[8] In Spain, only 4% of elementary students are enrolled in private non-publicly funded schools. Public and private but publicly funded "concerted" schools account for 68% and 28% of total elementary students in 2009, respectively, according to official statistics (Spanish Ministry of Education). Private schools that receive public funding must follow the same enrollment criteria as public schools.

of grade repetition. A one standard deviation increase in age at school enrollment lowers the probability of being held back during the first grades of primary school by 1.4 percentage points, a relevant effect given that the average elementary school grade retention rate is just 1.15% in Spain.[9] Finally, in the last column of Table 5, we explore the effect of school-entry age on students' social skills. We find that school-entry age is positively associated with the quality of fourth graders' relationships with their classmates. A one standard deviation increase in school-entry age lowers the probability that the student declares that he/she has a bad or very bad relationship with his/her classmates by approximately 0.7 percentage points (34%).

Next, we analyze whether the estimated school-entry age effects are heterogeneous in students' predetermined characteristics like parental education and immigration status. The estimates, summarized in Table 6, show that school-entry age effects are lower among students whose parents were born abroad. The same result was documented for public schools in Catalonia by Calsamiglia and Loviglio (2020). The authors argue that immigrant students might have experienced other educational systems in their country of origin, with different school-entry cutoff dates or simply more flexibility, leading to smaller school-entry estimated effects. Our estimates, in this case, do not support the hypothesis that better-educated Spanish parents can buffer the negative effect of their nine-year-old child being relatively young on his/her academic outcomes, as overall we do not find statistically significant effects of parental education. One exception is parental expectations for tertiary education. Mothers and fathers with a college education have larger school-entry age effects in this case. Similarly to our results, Calsamiglia and Loviglio (2020) also find small differences in school-entry age effects in elementary education, grade retention, and parental evaluations by parental education or gender. We come back to this issue in the next section.

6.2. School-Entry Age Effects in Grade 10.

Table 7 presents our estimates for age effects in 10th grade on students' academic performance. As was the case for 4th grade, OLS underestimates the school-entry age

[9] Calsamiglia and Loviglio (2020) also find, using administrative data of the universe of public schools in the Spanish region of Catalonia, that being one year younger at entrance increases the probability of retention during the first two grades of primary education by 4.3 percentage points, a large effect given that the average retention rate in their sample is about 3%.

effects, which now amount to 0.10σ, 0.09σ and 0.07σ in reading, science, and math, respectively, according to IV estimates. This, in turn, means that, comparing these estimates with those presented in Table 2, school-entry age effects on test scores appear to lower their magnitude by at least 60% between grades four and ten.

The estimates in Table 8 confirm that school-entry age still impacts students' expectations of educational attainment only one year before the end of compulsory education. A one standard deviation increase in age increases the reported probability of completing a tertiary degree by about 7 percentage points. Unfortunately, information on parental expectations is not available in the PISA estimation sample.

Regarding non-cognitive skills, the estimates in Table 8 attest that school-entry age increases students' collaborative problem-solving skills and academic ambition while it lowers test anxiety. The estimated effects amount to 0.04σ, 0.03σ and 0.03σ, respectively. Grade retention, an issue that gains relevance in Spain in lower secondary education[10], appears to decrease as school-entry age increases. A standard deviation increase in school-entry age is associated with a reduction in the probability of being held back in secondary school by about 10 percentage points (a 36% reduction).

Finally, Table 9 presents heterogeneous school-entry age effects in 10th-grade outcomes depending on students' predetermined characteristics. In contrast with our results for 4th grade, we find that parental education does play a relevant role in compensating for school-entry age effects in students' performance in reading and science in 10th grade. School-entry age effects more than half their size if both parents hold university degrees. This is also the case for students' expectations for tertiary education, grade retention, and non-cognitive skills like cooperative problem-solving skills and test anxiety. Indeed, younger cohort children whose father or mother holds a college degree can fully offset the negative school-entry age effect on cooperative problem-solving skills, test anxiety, and expectations for tertiary education at age 15.

Highly educated parents are more likely to be prepared in terms of human capital, economic resources, and information to invest in their children in response to negative shocks. Coherent with this hypothesis, Berniell and Estrada (2020) show, using GDA and PISA 2003-2012 data, that Spanish households with college-educated mothers spend

[10] According to the Spanish Ministry of Education, grade retention remains below 2% in elementary education and then it jumps above 7% in the first year of secondary education, remaining above 6% during lower secondary.

significantly more time with their children, but only on activities related to teaching their children. These findings, when combined with our results, suggest that Spanish college-educated parents might increase their involvement in their children's education activities, like homework and study habits, between grades four and ten. Factors like the increasing cognitive demand of courses from grade 4 onwards, or the fact that children start secondary education, a new educational level with subject teachers instead of self-contained classrooms, and when grade retention is a more common practice, can motivate parents to get more involved, and help explain our results.

6.3. Teaching Practices and School-Entry Age Effects.

In this section, we consider whether the instructional practices frequently used by elementary school teachers mitigate, exacerbate, or have no effect on the propagation of early maturity gaps. As previously argued, based on prior literature, we anticipate modern (traditional) teaching practices to soften (widen) the inequalities caused by a strict enrollment age rule.

Table 10 presents our estimates for the effect of the frequent use ("always" or "almost always") of different teaching practices used in elementary schools on school-entry age effects in 10th grade.[11] Properly speaking, we test whether school-entry age effects in grade 10 are heterogeneous in the teaching practices that were predominant in 2009, i.e., when PISA students were likely to be fourth graders, in elementary schools located in the same region and communities of the same level of urbanicity as where the secondary school is located. The low geographic mobility of Spanish families with children ensures that this approximation is valid for more than 90% of PISA students. To avoid omitted variables bias in this analysis of treatment effect heterogeneity by elementary school teacher practices, we follow Feigenberg et al. (2023) and introduce the

[11] Alternatively, and following Bietenbeck (2014) and Hidalgo-Cabrillana and Lopez-Mayan (2018), we rescaled the answers to each item by assigning a numerical value as follows: 0 to "Never or almost never", 0.33 to "Sometimes", 0.67 to "Almost always", and 1 to "Always". Thus, responses are interpreted as the proportion of the time used in the practice. The estimates, available upon request to the authors, lead to similar but less informative results as those in Tables 10 and 11 since the effect of teaching practices on school-entry age effects, as we discussed below, turns out to be non-monotonic. Our results are also robust to the use of a principal component analysis for dimension reduction.

interaction between predetermined controls in X_i, and the indicators of teaching practices.[12]

Our estimates show that, by 10th grade, school-entry age effects on test scores, cooperative problem-solving skills, educational expectations, academic ambition, and grade repetition are higher the larger the share of elementary school teachers declaring that they lecture or have students work individually during most or all of the class time. Conversely, school-entry age effects on test anxiety are lower if teachers "always" or "almost always" use any of these two traditional instruction methods. The size of the associated effects is quite substantial. A one standard deviation increase in the share of elementary teachers lecturing or having students work individually always or almost always increases the school-entry age gap in 10th grade on performance and problem-solving skills by approximately one-third. The corresponding effect on expectations for tertiary education amounts to approximately 55%. No significant interaction term is observed for the traditional teaching practice "I assign class work to students". Similarly, no statistically significant effect is estimated for the practices "I pose questions to students while I am lecturing" and "Students ask me their doubts while I am lecturing", which cannot be classified as either modern or traditional.

Evidence regarding the effect of modern teaching practices on the persistence of school-entry age effects is mixed. While having students make presentations always or almost always is found to exacerbate school-entry age gaps, and no significant effect is observed for "I promote open discussions among students," having students work in small groups always or almost always lowers school-entry age gaps on academic ambition and grade retention but it widens age gaps on text anxiety. The latter result is coherent with the corresponding finding for traditional practices, and they suggest that individual student practice is crucial to lower test anxiety.

To properly understand the estimates presented in Table 10, we next explore in Table 11 the non-monotonicity of the effect of teaching practices on school-entry age effects by estimating the effect of a specific dosage (Sometimes, Almost Always, and Always) of each teaching practice. Interestingly, our estimates suggest that it is the frequency with which elementary teachers use a specific practice in classroom instruction

[12] For efficiency reasons, we estimate a model that controls for entrance age, predetermined controls, indicators of teacher quality and level of development at the region and community size levels, the first principal component of the indicators of teaching practices used by primary teachers, and its interaction with previous controls.

that determines whether they exacerbate or buffer school-entry age effects. For instance, traditional teaching practices are also effective at compensating for school-entry age gaps whenever elementary teachers don't use them during most or all of the class time, but only sometimes. The higher the share of elementary teachers declaring that they lecture or have students work individually only sometimes, the lower the school entry-age gap on students' performance, non-cognitive skills, expectations for tertiary education, and grade repetition.

A similar picture emerges when analyzing modern practices like having students work in small groups or making presentations. These practices soften school-entry age effects on students' test scores, educational expectations, academic ambition, and grade retention when they are used only sometimes by elementary teachers. Conversely, modern practices can also widen school-entrance age gaps if elementary teachers use them almost exclusively in their class instruction. Remarkably, the buffering effect of having students work in small groups on students' academic ambition and grade repetition in primary education is only achieved if it is intensively but not exclusively (almost always) used in elementary education instruction.

7. Conclusions.

Nearly all education systems have a single annual cutoff date for school eligibility. This, in turn, causes some students to be almost one year older than others when they begin school. The international evidence agrees that these initial maturity differences have long-lasting effects on education. Older students perform better during compulsory education, accumulate more human capital, and are less likely to be diagnosed with learning disorders than their younger classmates (Bedard and Dhuey 2006, Elder and Lubotsky 2009).

Students' non-cognitive skills are thought to play a crucial role in the propagation of these early maturity gaps. Initial maturity gaps may affect children's non-cognitive skills like academic self-concept and, thus, their motivation to learn can be durably undermined. That might well be the case since skills accumulated in early childhood are complementary to later learning (Cuhna et al. 2006).

In this paper we study the evolution of school-entry age effects from elementary school to secondary school and consider whether teachers' choices about how to allocate

time across different instructional activities during elementary school affect the persistence of school-entry age gaps. In particular, we analyze whether school-entry age effects in secondary school are lower for students who had more exposure to different elementary school teaching practices, e.g. "modern"-style teaching versus "traditional"-style practices.

For this aim, we combine data from the 2009 General Diagnostic Assessment (GDA), conducted by the Spanish Ministry of Education, and the 2015 PISA edition for Spain, to assess fourth and tenth-graders' competencies, respectively. Both datasets inform about 1999-born students' self-reported age at school entry, family environment, performance, and non-cognitive skills. GDA also informs about elementary teachers' allocation of class time across nine instructional activities. The effect of school starting age is identified by instrumenting the students' reported age at school entry with the "expected" age at enrollment as defined by the strict application of regulations for school enrollment.

Our estimates show that school-entry age affects students' test scores, grade repetition, expectations for tertiary education, both in fourth and tenth grade, and non-cognitive skills like test anxiety, academic ambition, and cooperative problem-solving skills, in 10^{th} grade when this information is available. School-entry age effects on test scores are lower by at least 60% between grades four and ten, but they still amount to 0.1σ in math and reading in the tenth grade, when the student is 15 years old. College-educated parents can partially buffer the negative effect of their child being relatively young on the child's outcomes.

We also find that the relationship between elementary school teaching practices and school-entry age effects is nonlinear. It appears that it is the frequency with which elementary teachers use a specific practice in classroom instruction that determines whether they exacerbate or soften school-entry age effects. For instance, traditional teaching practices like lecturing or having students work individually are also effective at compensating for school-entrance age gaps whenever elementary teachers don't use them during most or all of the class time, but only sometimes. Equivalently, modern practices like having students work in small groups or making presentations also soften age effects on performance and educational expectations if elementary teachers use them only sometimes. However, the buffering effect of having students work in small groups on students' academic ambition and grade repetition is only achieved if this teaching

practice is used intensively, but not exclusively (almost always) used.

Thus, our research shows that extreme bias toward any teaching practice in elementary school, no matter whether it is modern or traditional, is likely to exacerbate school-entry age effects. Conversely, school-entry age effects are totally or partially mitigated when elementary teachers follow a more balanced approach that combines different teaching styles.

Therefore, our findings suggest that teaching practices can be effectively used to compensate for the long-run consequences of early maturity differences. Elementary school teachers who do not rely exclusively or intensively on only one specific teaching practice, but combine different practices in their classroom instruction, appear to be the most efficient at buffering the social inequality caused by the strict application of school-entry age requirements in primary school laws.

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Table 1. Descriptive statistics.

	Grade 4	Grade 10
Age at school entry (months)	30.75	50.02
	(9.71)	(12.48)
Female	49.72	49.45
Immigrant father	11.21	13.72
Immigrant mother	10.34	14.53
Mother, college	29.79	31.96
Mother, bachelor	34.88	34.98
Mother, compulsory	25.91	21.99
Father, college	24.81	27.27
Father, bachelor	35.45	35.79
Father, compulsory	27.28	23.15
High SES	22.77	25.19
Upper av. SES	21.75	24.77
Lower av. SES	22.58	24.97
Private school	38.27	31.96
Books at home		
101 - 200	16.83	20.66
201 - 500	10.97	16.42
More than 500	10.85	8.42
Community size		
Less than 2,000	3.96	5.51
2,000 - 10,000	17.4	27.97
10,000 - 50,000	30.07	33.13
50,000 - 500,000	38.02	28.43
More than 500,000	10.55	4.97
N	24,757	29,771

Notes: We use GDA 2009 and PISA 2015 data to characterize students in 4th and 10th grade, respectively.

Table 2. School-Entry Age and Student Performance. Grade 4.

	Reading		Math		Science		Social sciences	
	OLS	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Age at entry	0.001	0.026***	0.002**	0.027***	0.002**	0.026***	0.002**	0.027***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Female	0.120***	0.117***	-0.146***	-0.149***	-0.047***	-0.050***	0.198***	0.194***
	(0.013)	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.014)
Immigrant father	-0.161***	-0.262***	-0.125***	-0.226***	-0.126***	-0.219***	-0.099***	-0.198***
	(0.030)	(0.032)	(0.031)	(0.033)	(0.030)	(0.032)	(0.030)	(0.032)
Immigrant mother	-0.108***	-0.189***	-0.124***	-0.205***	-0.153***	-0.227***	-0.063**	-0.142***
	(0.031)	(0.033)	(0.031)	(0.033)	(0.031)	(0.033)	(0.030)	(0.032)
Mother, college	0.468***	0.551***	0.404***	0.488***	0.476***	0.552***	0.440***	0.521***
	(0.030)	(0.032)	(0.030)	(0.031)	(0.031)	(0.032)	(0.031)	(0.032)
Mother, bachelor	0.294***	0.359***	0.236***	0.301***	0.302***	0.362***	0.300***	0.363***
	(0.028)	(0.029)	(0.027)	(0.028)	(0.028)	(0.029)	(0.028)	(0.030)
Mother, compulsory	0.172***	0.201***	0.146***	0.176***	0.186***	0.214***	0.145***	0.174***
	(0.028)	(0.029)	(0.027)	(0.028)	(0.028)	(0.029)	(0.029)	(0.030)
Father, college	0.361***	0.401***	0.342***	0.382***	0.365***	0.402***	0.355***	0.395***
	(0.028)	(0.029)	(0.028)	(0.029)	(0.028)	(0.028)	(0.028)	(0.029)
Father, bachelor	0.234***	0.260***	0.184***	0.211***	0.224***	0.248***	0.213***	0.240***
	(0.024)	(0.025)	(0.025)	(0.026)	(0.024)	(0.025)	(0.025)	(0.026)
Father, compulsory	0.098***	0.110***	0.076***	0.088***	0.117***	0.128***	0.124***	0.137***
	(0.024)	(0.025)	(0.024)	(0.025)	(0.024)	(0.025)	(0.025)	(0.026)
Constant	-0.574***	-1.440***	-0.513***	-1.382***	-0.543***	-1.339***	-0.642***	-1.493***
	(0.048)	(0.074)	(0.047)	(0.073)	(0.048)	(0.072)	(0.049)	(0.074)
N	18,952	18,952	18,952	18,952	18,895	18,895	18,851	18,851

Notes: All the models are estimated using GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates also control for the number of books at home, the region of residence, and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Std indicates that the variable has been standardized at the region level.

Table 3. First Stage Estimates. Grade 4.

	Age at entry
Expected Age at entry	1.086***
	(0.015)
Female	0.156
	(0.104)
Immigrant father	3.807***
	(0.288)
Immigrant mother	3.325***
	(0.296)
Mother, college	-3.150***
	(0.270)
Mother, bachelor	-2.373***
	(0.258)
Mother, compulsory	-1.221***
	(0.255)
Father, college	-1.282***
	(0.230)
Father, bachelor	-0.866***
	(0.210)
Father, compulsory	-0.329
	(0.206)
F-Stat	220.08
R2	0.300
Cragg-Donald test, p-value	0.000
Hansen J statistic	0.000
N	18,952

Notes: The model is estimated using GDA 2009 data. The entries are the coefficient and robust standard error in parentheses. The estimates also control for the number of books at home, the region of residence, and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels.

Table 4. School-Entry Age and Student Performance in Grade 4.

Alternative Specifications.

Baseline	**Reading**	**Math**	**Science**	**Social Sciences**
Age at entry	0.026***	0.027***	0.026***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)
N	18,952	18,952	18,895	18,851
R2	0.083	0.080	0.134	0.096
+ controls for SES				
Age at entry	0.026***	0.027***	0.025***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)
N	18,952	18,952	18,895	18,851
R2	0.088	0.086	0.138	0.100
+ control for private school				
Age at entry	0.026***	0.027***	0.025***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)
N	18,952	18,952	18,895	18,851
R2	0.088	0.086	0.138	0.100
Private school				
Age at entry	0.030***	0.031***	0.031***	0.030***
	(0.003)	(0.003)	(0.003)	(0.003)
N	7,304	7,304	7,278	7,273
R2	0.122	0.108	0.164	0.134
Public school				
Age at entry	0.027***	0.028***	0.025***	0.028***
	(0.003)	(0.002)	(0.002)	(0.003)
N	11,648	11,648	11,617	11,578
R2	0.112	0.120	0.165	0.128

Notes: All the models are estimated using GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The baseline specification controls for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Age at entry is standardized at the region level.

Table 5. School-Entry Age, Grade Repetition, Expectations, and Social Skills. Grade 4.

	Which of the following do you expect to complete?						
	Compulsory education	Vocational educational	Bachelor	College	Still don't know	**Grade repetition**	**Relationship with peers**
Age at entry	-0.006	-0.003	-0.008*	0.015***	-0.012***	-0.014*	-0.007*
	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.008)	(0.004)

	Which of the following do you expect your child to complete?				
	Compulsory education	Vocational (lower)	Bachelor	Vocational (upper)	College
Age at entry	-0.005	-0.004	-0.005	-0.005	0.009***
	(0.006)	(0.007)	(0.005)	(0.004)	(0.003)

Notes: All the models are estimated using GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Age at entry is standardized at the region level.

Table 6. Heterogeneity in School-Entry Age Effects. Grade 4.

	Performance in reading						
Age at entry	0.024***	0.027***	0.027***	0.024***	0.025***	0.026***	0.026***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.003	-0.011*	-0.009	0.008*	0.004	-0.000	-0.006
	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
	Performance in math						
Age at entry	0.025***	0.028***	0.028***	0.026***	0.025***	0.027***	0.027***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.005	-0.009	-0.006	0.003	0.007	-0.000	-0.001
	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
	Performance in Science						
Age at entry	0.023***	0.026***	0.026***	0.024***	0.024***	0.025***	0.026***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.005	-0.009	-0.010*	0.005	0.003	0.001	-0.006
	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
	Performance in Social Sciences						
Age at entry	0.026***	0.027***	0.028***	0.027***	0.027***	0.026***	0.027***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.002	-0.004	-0.009	0.001	0.001	0.009	0.001
	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
	Grade repetition						
Age at entry	-0.005	-0.011	-0.013	-0.011	-0.011	-0.010	-0.012
	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.017	-0.008	0.002	-0.013	-0.011	-0.015	-0.002
	(0.015)	(0.018)	(0.018)	(0.020)	(0.019)	(0.018)	(0.016)
	Social capital						
Age at entry	-0.010*	-0.008**	-0.007*	-0.011***	-0.010**	-0.011***	-0.012***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.002	-0.019*	-0.024**	0.000	-0.002	0.003	0.009
	(0.007)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.011)
	Child expectations for tertiary education						
Age at entry	0.019***	0.020***	0.022***	0.016***	0.019***	0.018***	0.019***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.001	-0.006	-0.017**	0.004	0.004	0.004	0.005
	(0.005)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.009)
	Parental expectations for tertiary education						
Age at entry	0.009*	0.012***	0.012***	0.009***	0.009***	0.011***	0.013***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.008	0.004	-0.001	0.024**	0.015*	0.008	-0.008
	(0.006)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)

Notes: All the models are estimated using GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Following Feigenberg et al. (2023), and to avoid omitted variables bias when estimating interaction terms, we further control for the interaction between predetermined controls in X_i and the "*interacted with*" variable. Age at entry is standardized at the region level.

Table 7. School-Entry Age and student performance. Grade 10.

	Reading				Math				Science			
	OLS	IV			OLS	IV			OLS	IV		
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Age at entry	0.043***	0.101***	0.100***	0.048***	0.022***	0.073***	0.072***	0.008	0.033***	0.094***	0.093***	0.039***
	(0.006)	(0.014)	(0.014)	(0.015)	(0.006)	(0.014)	(0.014)	(0.015)	(0.006)	(0.014)	(0.014)	(0.014)
Female	0.153***	0.148***	0.148***	0.090***	-0.174***	-0.179***	-0.179***	-0.253***	-0.113***	-0.118***	-0.119***	-0.181***
	(0.011)	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.011)	(0.012)	(0.010)	(0.010)	(0.010)	(0.011)
Immigrant father	-0.079***	-0.085***	-0.071***	-0.023	-0.125***	-0.131***	-0.116***	-0.059**	-0.099***	-0.105***	-0.093***	-0.029
	(0.022)	(0.023)	(0.022)	(0.026)	(0.022)	(0.022)	(0.022)	(0.026)	(0.022)	(0.022)	(0.022)	(0.024)
Immigrant mother	-0.031	-0.038*	-0.026	0.054**	-0.154***	-0.160***	-0.147***	-0.088***	-0.096***	-0.103***	-0.093***	-0.030
	(0.022)	(0.022)	(0.022)	(0.026)	(0.022)	(0.022)	(0.022)	(0.025)	(0.021)	(0.021)	(0.021)	(0.024)
Mother, vocational ed	0.113***	0.113***	0.084***	0.007	0.129***	0.129***	0.098***	0.025	0.179***	0.179***	0.159***	0.078***
	(0.021)	(0.021)	(0.022)	(0.024)	(0.021)	(0.021)	(0.022)	(0.025)	(0.021)	(0.021)	(0.021)	(0.023)
Mother, upper secondary	0.147***	0.147***	0.093***	0.003	0.185***	0.185***	0.128***	0.042*	0.160***	0.160***	0.120***	0.024
	(0.018)	(0.018)	(0.020)	(0.022)	(0.018)	(0.018)	(0.019)	(0.022)	(0.018)	(0.018)	(0.019)	(0.020)
Mother, university degree	0.078***	0.082***	0.012	-0.038*	0.059***	0.062***	-0.011	-0.055**	0.051***	0.055***	0.003	-0.053**
	(0.018)	(0.018)	(0.020)	(0.022)	(0.018)	(0.018)	(0.019)	(0.022)	(0.017)	(0.018)	(0.019)	(0.021)
Mother, PhD	0.151***	0.151***	-0.001	-0.042*	0.229***	0.229***	0.074***	0.031	0.201***	0.201***	0.077***	0.028
	(0.016)	(0.016)	(0.020)	(0.022)	(0.016)	(0.016)	(0.020)	(0.022)	(0.016)	(0.016)	(0.020)	(0.021)
Father, vocational ed	0.117***	0.117***	0.095***	0.057**	0.091***	0.090***	0.068***	0.027	0.166***	0.165***	0.150***	0.102***
	(0.022)	(0.022)	(0.022)	(0.025)	(0.022)	(0.022)	(0.022)	(0.024)	(0.021)	(0.021)	(0.021)	(0.023)
Father, upper secondary	0.151***	0.150***	0.103***	0.049**	0.152***	0.151***	0.102***	0.054**	0.156***	0.155***	0.120***	0.065***
	(0.019)	(0.019)	(0.020)	(0.022)	(0.019)	(0.019)	(0.020)	(0.022)	(0.019)	(0.019)	(0.019)	(0.020)
Father, university degree	0.080***	0.080***	0.021	0.005	0.041**	0.041**	-0.021	-0.051***	0.060***	0.060***	0.014	-0.009
	(0.017)	(0.017)	(0.018)	(0.020)	(0.017)	(0.017)	(0.018)	(0.020)	(0.016)	(0.016)	(0.017)	(0.019)
Father, PhD	0.173***	0.170***	0.041**	0.019	0.160***	0.157***	0.025	0.009	0.180***	0.177***	0.071***	0.051***
	(0.016)	(0.017)	(0.019)	(0.021)	(0.016)	(0.016)	(0.019)	(0.020)	(0.016)	(0.016)	(0.018)	(0.019)
Controls for SES	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Excluding repeaters	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
N	29,740	29,740	29,740	20,963	29,740	29,740	29,740	20,963	29,740	29,740	29,740	20,963
R2	0.1618	0.1585	0.1648	0.0912	0.1868	0.1843	0.1912	0.122	0.2056	0.202	0.2063	0.1379

Notes: All the models are estimated using PISA 2015 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Age at entry is standardized at the region level.

Table 8. School-Entry Age, Expectations, Non-Cognitive Skills, and Grade Repetition. Grade 10.

	Which of the following do you expect to complete?				
	Lower secondary	Vocational training	Upper secondary	Tertiary degree	Don't know
Age at entry	-0.049*	-0.051	-0.036	0.071***	0.044
	(0.027)	(0.033)	(0.023)	(0.021)	(0.088)

	Non-cognitive skills						
	Collaborative Problem Solving	Test anxiety	Academic ambition	Belonging	Life satisfaction	Relationship with teachers	Bullying
Age at entry	0.041***	-0.033**	0.031**	-0.038	-0.020	0.023	0.018
	(0.011)	(0.015)	(0.015)	(0.029)	(0.031)	(0.025)	(0.029)

	Grade repetition					
	Primary		Secondary		Both	
	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Age at entry	-0.013	-0.288***	-0.069***	-0.101***	-0.027**	-0.225***
	(0.014)	(0.037)	(0.010)	(0.026)	(0.012)	(0.032)

Notes: All the models are estimated using PISA 2015 data. The entries for each model are the coefficient and robust standard error in parenthesis. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The indicator of Collaborative Problem-Solving Skills is the first plausible value provided in PISA 2015. Test Anxiety is the first principal component of responses to statements in question ST118. Equivalently, Academic Ambition, Belonging and Bullying are obtained as the first principal component of responses to statements in question ST119, ST034 and ST038, respectively. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% significance levels. Age at entry is standardized at the region level.

Table 9. Heterogeneity in School-Entry Age Effects. Grade 10.

	Performance in reading						
Age at entry	0.105***	0.100***	0.098***	0.123***	0.119***	0.094***	0.096***
	(0.021)	(0.015)	(0.015)	(0.019)	(0.019)	(0.017)	(0.017)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.009	-0.001	0.014	-0.055**	-0.042	0.017	0.012
	(0.028)	(0.044)	(0.042)	(0.028)	(0.028)	(0.029)	(0.030)
	Performance in math						
Age at entry	0.082***	0.070***	0.067***	0.084***	0.089***	0.073***	0.066***
	(0.021)	(0.015)	(0.015)	(0.018)	(0.019)	(0.017)	(0.016)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.021	0.017	0.036	-0.029	-0.037	-0.005	0.018
	(0.027)	(0.042)	(0.041)	(0.027)	(0.027)	(0.028)	(0.030)
	Performance in science						
Age at entry	0.092***	0.093***	0.092***	0.118***	0.115***	0.084***	0.081***
	(0.021)	(0.014)	(0.015)	(0.018)	(0.019)	(0.017)	(0.016)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.001	0.003	0.005	-0.057**	-0.048*	0.024	0.037
	(0.027)	(0.044)	(0.041)	(0.027)	(0.027)	(0.028)	(0.030)
	Collaborative Problem Solving Skills						
Age at entry	0.042***	0.038***	0.038***	0.059***	0.047***	0.034***	0.040***
	(0.016)	(0.011)	(0.011)	(0.014)	(0.015)	(0.013)	(0.013)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.001	0.026	0.029	-0.040*	-0.012	0.020	0.005
	(0.021)	(0.034)	(0.032)	(0.021)	(0.021)	(0.022)	(0.023)
	Test Anxiety						
Age at entry	-0.046**	-0.033**	-0.038**	-0.016	-0.008	-0.052***	-0.046***
	(0.023)	(0.016)	(0.016)	(0.020)	(0.021)	(0.018)	(0.017)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.025	0.002	0.038	-0.039	-0.054*	0.055*	0.043
	(0.030)	(0.046)	(0.044)	(0.029)	(0.029)	(0.031)	(0.032)
	Academic Ambition						
Age at entry	0.014	0.025	0.023	0.033*	0.033	0.022	0.024
	(0.022)	(0.016)	(0.016)	(0.020)	(0.021)	(0.018)	(0.017)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.032	0.044	0.054	-0.006	-0.006	0.024	0.020
	(0.029)	(0.048)	(0.045)	(0.029)	(0.029)	(0.031)	(0.032)

Table 9. Heterogeneity in School-Entry Age Effects. Grade 10. (Cont.)

	Expect to complete compulsory education						
Age at entry	-0.046	-0.063**	-0.058*	-0.036	-0.069**	-0.062	-0.019
	(0.039)	(0.030)	(0.030)	(0.033)	(0.034)	(0.038)	(0.037)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.007	0.087	0.054	-0.042	0.062	0.028	-0.066
	(0.055)	(0.079)	(0.076)	(0.059)	(0.058)	(0.055)	(0.055)
	Expect to complete vocational education						
Age at entry	-0.004	-0.063*	-0.059	-0.024	-0.079*	-0.086*	-0.079*
	(0.044)	(0.036)	(0.036)	(0.039)	(0.040)	(0.046)	(0.045)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.114*	0.074	0.047	-0.094	0.091	0.071	0.062
	(0.067)	(0.092)	(0.088)	(0.073)	(0.070)	(0.066)	(0.066)
	Expect to complete bachelor degree						
Age at entry	-0.032	-0.032	-0.034	-0.051*	-0.061*	-0.039	-0.045
	(0.034)	(0.025)	(0.025)	(0.031)	(0.032)	(0.029)	(0.028)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.008	-0.026	-0.016	0.036	0.058	0.007	0.026
	(0.047)	(0.071)	(0.067)	(0.047)	(0.047)	(0.048)	(0.050)
	Expect to complete tertiary education						
Age at entry	0.060*	0.079***	0.077***	0.076***	0.130***	0.078***	0.056**
	(0.031)	(0.023)	(0.023)	(0.028)	(0.028)	(0.027)	(0.026)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.022	-0.054	-0.036	-0.013	-0.142***	-0.018	0.042
	(0.043)	(0.065)	(0.062)	(0.044)	(0.043)	(0.044)	(0.045)
	Grade repetition in primary						
Age at entry	-0.266***	-0.333***	-0.356***	-0.280***	-0.318***	-0.298***	-0.250***
	(0.057)	(0.044)	(0.044)	(0.049)	(0.049)	(0.053)	(0.052)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	-0.022	0.226**	0.292***	0.012	0.117	0.047	-0.064
	(0.082)	(0.099)	(0.094)	(0.087)	(0.085)	(0.082)	(0.084)
	Grade repetition in secondary						
Age at entry	-0.076**	-0.085***	-0.092***	-0.044	-0.015	-0.095***	-0.096***
	(0.039)	(0.029)	(0.030)	(0.034)	(0.035)	(0.037)	(0.035)
Interacted with	*Female*	*Immigrant father*	*Immigrant mother*	*Father college*	*Mother college*	*Father primary*	*Mother primary*
Interaction term	0.011	0.094	0.127*	-0.081	-0.153***	0.053	0.064
	(0.054)	(0.077)	(0.074)	(0.057)	(0.056)	(0.054)	(0.055)

Notes: All the models are estimated using PISA 2015 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Following Feigenberg et al. (2023), and to avoid omitted variables bias when estimating interaction terms, we further control for the interaction between predetermined controls in X_i and the "*interacted with*" variable. Age at entry is standardized at the region level.

Table 10. Teaching Practices in Elementary School and School- Entry Age effects. Grade 10.

	Performance in reading								
Age at entry	0.102***	0.101***	0.101***	0.100***	0.101***	0.101***	0.100***	0.101***	0.101***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	0.033**	0.048***	0.004	0.027**	0.006	0.013	0.028**	0.005	0.002
	(0.015)	(0.015)	(0.016)	(0.013)	(0.015)	(0.014)	(0.013)	(0.011)	(0.011)
	Performance in math								
Age at entry	0.077***	0.075***	0.076***	0.075***	0.076***	0.075***	0.075***	0.076***	0.076***
	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	0.036*	0.047***	0.001	0.023	0.010	0.014	0.030**	0.007	0.006
	(0.018)	(0.017)	(0.018)	(0.015)	(0.017)	(0.015)	(0.014)	(0.012)	(0.012)
	Performance in science								
Age at entry	0.098***	0.097***	0.097***	0.096***	0.097***	0.096***	0.096***	0.097***	0.097***
	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	0.032*	0.034*	0.001	0.027**	-0.004	0.016	0.034**	0.010	-0.003
	(0.018)	(0.018)	(0.017)	(0.014)	(0.016)	(0.011)	(0.015)	(0.013)	(0.013)
	Collaborative Problem Solving Skills								
Age at entry	0.113***	0.111***	0.112***	0.111***	0.112***	0.112***	0.111***	0.112***	0.112***
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	0.040**	0.029	-0.005	0.019	-0.006	-0.003	0.040***	0.009	0.007
	(0.016)	(0.019)	(0.017)	(0.014)	(0.018)	(0.012)	(0.015)	(0.014)	(0.012)
	Test Anxiety								
Age at entry	-0.033*	-0.033*	-0.033*	-0.033*	-0.033*	-0.033*	-0.034*	-0.033*	-0.033*
	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)	(0.017)	(0.018)	(0.018)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	0.011	-0.024	0.016	-0.006	0.017	0.013	0.041**	-0.033*	0.024
	(0.017)	(0.015)	(0.018)	(0.018)	(0.021)	(0.021)	(0.016)	(0.018)	(0.016)
	Academic Ambition								
Age at entry	0.029**	0.029**	0.029**	0.030**	0.029**	0.029**	0.028**	0.029**	0.029**
	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Interaction term	-0.005	-0.022*	0.023	-0.011	-0.015	-0.009	0.041***	-0.018	-0.011
	(0.016)	(0.013)	(0.020)	(0.024)	(0.017)	(0.016)	(0.013)	(0.017)	(0.014)

Table 10. Teaching Practices in Elementary School and School- Entry Age effects. Grade 10. (Cont.)

	Expect to complete vocational education								
Age at entry	-0.046	-0.051	-0.050	-0.051	-0.051	-0.051	-0.049	-0.048	-0.052
	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)	(0.034)	(0.033)	(0.034)
		Students	Pose questions	Students ask	Promote	Assign class	Students work	Students work	Adapt activities
Interacted with	Lecturing	make presentations	while lecturing	doubts while lecturing	Open Discussions	work to students	individually	in small groups	to students
Interaction term	-0.090***	-0.082**	0.016	0.033	-0.038	0.059*	-0.002	0.044	0.037
	(0.034)	(0.035)	(0.036)	(0.038)	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)
	Expect to complete bachelor degree								
Age at entry	-0.037	-0.035	-0.036	-0.035	-0.036	-0.036	-0.034	-0.035	-0.035
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
		Students	Pose questions	Students ask	Promote	Assign class	Students work	Students work	Adapt activities
Interacted with	Lecturing	make presentations	while lecturing	doubts while lecturing	Open Discussions	work to students	individually	in small groups	to students
Interaction term	-0.050**	-0.009	0.012	-0.008	0.031	0.036	-0.032	0.023	0.007
	(0.024)	(0.026)	(0.026)	(0.026)	(0.025)	(0.026)	(0.024)	(0.024)	(0.024)
	Expect to complete tertiary education								
Age at entry	0.071***	0.070***	0.070***	0.069***	0.070***	0.070***	0.068***	0.070***	0.070***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
		Students	Pose questions	Students ask	Promote	Assign class	Students work	Students work	Adapt activities
Interacted with	Lecturing	make presentations	while lecturing	doubts while lecturing	Open Discussions	work to students	individually	in small groups	to students
Interaction term	0.062***	0.006	0.001	0.021	-0.015	-0.023	0.045**	-0.036*	0.010
	(0.022)	(0.023)	(0.024)	(0.024)	(0.022)	(0.023)	(0.022)	(0.022)	(0.022)
	Grade repetition in primary								
Age at entry	-0.270***	-0.268***	-0.269***	-0.269***	-0.268***	-0.269***	-0.267***	-0.270***	-0.269***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
		Students	Pose questions	Students ask	Promote	Assign class	Students work	Students work	Adapt activities
Interacted with	Lecturing	make presentations	while lecturing	doubts while lecturing	Open Discussions	work to students	individually	in small groups	to students
Interaction term	-0.021	0.022	0.016	0.005	-0.021	-0.005	-0.074*	0.089**	0.045
	(0.043)	(0.044)	(0.045)	(0.047)	(0.041)	(0.043)	(0.042)	(0.042)	(0.041)
	Grade repetition in secondary								
Age at entry	-0.068**	-0.068**	-0.069**	-0.069**	-0.068**	-0.069**	-0.068**	-0.068**	-0.069**
	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)	(0.027)
		Students	Pose questions	Students ask	Promote	Assign class	Students work	Students work	Adapt activities
Interacted with	Lecturing	make presentations	while lecturing	doubts while lecturing	Open Discussions	work to students	individually	in small groups	to students
Interaction term	0.017	0.015	0.015	0.021	0.009	0.017	0.004	-0.005	0.046*
	(0.028)	(0.030)	(0.031)	(0.030)	(0.028)	(0.030)	(0.028)	(0.028)	(0.027)

Notes: All the models are estimated using PISA 2015 and GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Following Feigenberg et al. (2023), and to avoid omitted variables bias when estimating interaction terms, we further control for the interaction between predetermined controls and the first principal component of the different teaching practices. Age at entry is standardized at the region level.

Table 11. The Effect of a Specific Dosage of Teaching Practices in Elementary School on School- Entry Age effects. Grade 10.

	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Performance in reading									
Age at entry	0.101***	0.101***	0.101***	0.100***	0.101***	0.101***	0.100***	0.101***	0.101***
	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)
Sometimes	-0.025*	-0.040***	-0.010	-0.029**	-0.002	-0.015	-0.029**	0.006	-0.002
	(0.014)	(0.014)	(0.017)	(0.012)	(0.015)	(0.015)	(0.012)	(0.012)	(0.011)
Almost always	0.028*	0.050***	0.003	0.017	0.005	-0.005	0.031**	0.009	-0.003
	(0.015)	(0.018)	(0.012)	(0.015)	(0.013)	(0.013)	(0.013)	(0.014)	(0.011)
Always	0.018	0.005	-0.002	-0.003	0.002	0.009	0.003	-0.003	0.008
	(0.016)	(0.013)	(0.012)	(0.013)	(0.011)	(0.013)	(0.012)	(0.010)	(0.013)
Performance in math									
Age at entry	0.076***	0.075***	0.076***	0.075***	0.076***	0.076***	0.075***	0.076***	0.076***
	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Sometimes	-0.024	-0.044***	-0.009	-0.021	-0.004	-0.011	-0.030**	0.006	-0.001
	(0.019)	(0.015)	(0.019)	(0.014)	(0.015)	(0.015)	(0.013)	(0.013)	(0.013)
Almost always	0.022	0.048***	0.008	0.021	0.020	-0.000	0.025	0.015	0.011
	(0.018)	(0.018)	(0.015)	(0.016)	(0.016)	(0.012)	(0.015)	(0.015)	(0.014)
Always	0.040**	0.004	-0.008	-0.007	-0.013	0.005	0.014	-0.006	-0.007
	(0.017)	(0.022)	(0.013)	(0.014)	(0.013)	(0.012)	(0.016)	(0.009)	(0.019)
Performance in science									
Age at entry	0.097***	0.096***	0.097***	0.096***	0.097***	0.096***	0.096***	0.097***	0.097***
	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)
Sometimes	-0.026	-0.033**	-0.011	-0.028**	0.006	-0.017	-0.037***	0.002	0.005
	(0.018)	(0.017)	(0.018)	(0.013)	(0.015)	(0.013)	(0.012)	(0.015)	(0.013)
Almost always	0.021	0.032*	0.006	0.028**	0.011	-0.006	0.032**	0.012	-0.003
	(0.018)	(0.018)	(0.015)	(0.014)	(0.014)	(0.013)	(0.016)	(0.017)	(0.015)
Always	0.031*	0.011	-0.006	-0.012	-0.018	0.011	0.011	0.002	0.000
	(0.017)	(0.020)	(0.013)	(0.013)	(0.012)	(0.013)	(0.014)	(0.010)	(0.019)
Collaborative Problem Solving Skills									
Age at entry	0.112***	0.111***	0.111***	0.111***	0.112***	0.112***	0.111***	0.112***	0.112***
	(0.013)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.013)	(0.015)	(0.015)
Sometimes	-0.040***	-0.023	-0.005	-0.025*	0.004	-0.002	-0.045***	0.000	-0.012
	(0.015)	(0.017)	(0.016)	(0.014)	(0.017)	(0.013)	(0.012)	(0.015)	(0.013)
Almost always	0.031**	0.020	0.002	0.030**	0.000	-0.005	0.035**	0.004	0.001
	(0.015)	(0.021)	(0.015)	(0.013)	(0.015)	(0.014)	(0.016)	(0.018)	(0.013)
Always	0.029*	0.023**	-0.004	-0.018	-0.008	0.003	0.016	0.009	0.007
	(0.016)	(0.011)	(0.013)	(0.011)	(0.013)	(0.014)	(0.013)	(0.007)	(0.015)
Test Anxiety									
Age at entry	-0.033*	-0.032*	-0.033*	-0.032*	-0.033*	-0.033*	-0.033*	-0.033*	-0.033*
	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)
Sometimes	-0.010	0.040**	0.003	0.013	-0.001	0.001	-0.030**	0.025	-0.018
	(0.012)	(0.016)	(0.017)	(0.019)	(0.020)	(0.024)	(0.015)	(0.017)	(0.015)
Almost always	0.007	-0.017	-0.025	-0.040**	-0.006	-0.020	0.031**	-0.018	-0.007
	(0.017)	(0.016)	(0.018)	(0.017)	(0.019)	(0.012)	(0.015)	(0.019)	(0.019)
Always	0.010	-0.020	0.035*	0.032*	0.028	0.023	0.024	-0.032	0.039**
	(0.016)	(0.017)	(0.018)	(0.017)	(0.017)	(0.015)	(0.017)	(0.027)	(0.019)
Academic Ambition									
Age at entry	0.029**	0.029**	0.029**	0.030**	0.029**	0.030**	0.028**	0.029**	0.029**
	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)
Sometimes	0.009	0.021*	-0.003	0.020	0.019	0.022	-0.034**	0.013	0.010
	(0.016)	(0.013)	(0.021)	(0.025)	(0.016)	(0.014)	(0.014)	(0.016)	(0.014)
Almost always	-0.009	-0.020	-0.016	-0.003	-0.011	0.009	0.022	-0.029*	0.006
	(0.018)	(0.017)	(0.015)	(0.012)	(0.014)	(0.014)	(0.015)	(0.016)	(0.010)
Always	0.008	-0.008	0.028**	-0.003	-0.005	-0.012	0.034***	0.006	-0.022
	(0.011)	(0.018)	(0.014)	(0.015)	(0.015)	(0.014)	(0.011)	(0.012)	(0.016)
Expect to complete vocational education									
Age at entry	-0.047	-0.051	-0.049	-0.050	-0.051	-0.050	-0.048	-0.047	-0.051
	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)	(0.034)	(0.033)	(0.034)
Sometimes	0.063**	0.080**	-0.002	-0.027	0.043	-0.053	0.005	-0.056*	-0.026
	(0.032)	(0.034)	(0.037)	(0.039)	(0.034)	(0.036)	(0.034)	(0.034)	(0.033)
Almost always	-0.058*	-0.055	0.053	-0.012	-0.005	-0.029	-0.037	0.035	0.050
	(0.034)	(0.035)	(0.032)	(0.032)	(0.031)	(0.033)	(0.034)	(0.035)	(0.031)
Always	-0.084**	-0.068**	-0.051	0.024	-0.040	0.047	0.041	0.022	-0.024
	(0.034)	(0.032)	(0.032)	(0.032)	(0.032)	(0.033)	(0.031)	(0.028)	(0.034)
Expect to complete bachelor degree									
Age at entry	-0.036	-0.035	-0.036	-0.035	-0.037	-0.037	-0.034	-0.036	-0.035
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Sometimes	0.035	0.016	-0.012	-0.003	-0.040	-0.052**	0.023	-0.013	-0.010
	(0.023)	(0.025)	(0.027)	(0.027)	(0.025)	(0.027)	(0.024)	(0.024)	(0.023)
Almost always	-0.036	-0.004	0.024	0.016	0.004	0.008	-0.018	0.022	0.030
	(0.024)	(0.027)	(0.024)	(0.024)	(0.023)	(0.024)	(0.024)	(0.026)	(0.023)
Always	-0.043*	-0.012	-0.020	-0.017	0.033	0.005	-0.026	0.011	-0.032
	(0.024)	(0.023)	(0.024)	(0.024)	(0.023)	(0.024)	(0.023)	(0.022)	(0.025)

Table 11.The Effect of a Specific Dosage of Teaching Practices in Elementary School on School- Entry Age effects. Grade 10. (Cont.)

	Expect to complete tertiary education								
Age at entry	0.070***	0.070***	0.070***	0.069***	0.070***	0.071***	0.068***	0.070***	0.070***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Sometimes	-0.026	-0.013	-0.002	-0.010	0.020	0.037	-0.039*	0.033	-0.002
	(0.021)	(0.023)	(0.024)	(0.025)	(0.023)	(0.024)	(0.022)	(0.022)	(0.021)
Almost always	0.039*	-0.001	-0.019	-0.011	0.007	-0.010	0.038*	-0.025	-0.020
	(0.022)	(0.024)	(0.022)	(0.021)	(0.021)	(0.022)	(0.022)	(0.023)	(0.021)
Always	0.066***	0.017	0.021	0.018	-0.027	0.001	0.019	-0.026	0.041*
	(0.022)	(0.021)	(0.022)	(0.021)	(0.021)	(0.022)	(0.021)	(0.019)	(0.023)
	Grade repetition in primary								
Age at entry	-0.271***	-0.269***	-0.269***	-0.269***	-0.268***	-0.268***	-0.267***	-0.269***	-0.269***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Sometimes	0.032	0.004	-0.018	0.002	0.015	0.009	0.071*	-0.050	-0.029
	(0.041)	(0.043)	(0.046)	(0.049)	(0.041)	(0.045)	(0.043)	(0.042)	(0.040)
Almost always	0.019	0.025	0.029	0.009	0.006	0.020	-0.046	0.087**	-0.006
	(0.044)	(0.045)	(0.041)	(0.040)	(0.039)	(0.040)	(0.042)	(0.044)	(0.039)
Always	-0.090**	-0.000	-0.025	-0.005	-0.037	-0.022	-0.052	0.033	0.069
	(0.042)	(0.043)	(0.041)	(0.040)	(0.040)	(0.041)	(0.040)	(0.038)	(0.045)
	Grade repetition in secondary								
Age at entry	-0.068**	-0.068**	-0.069**	-0.069**	-0.068**	-0.068**	-0.068**	-0.068**	-0.070**
	(0.027)	(0.027)	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)	(0.027)
Interacted with	Lecturing	Students make presentations	Pose questions while lecturing	Students ask doubts while lecturing	Promote Open Discussions	Assign class work to students	Students work individually	Students work in small groups	Adapt activities to students
Sometimes	-0.019	0.001	-0.009	-0.016	-0.003	-0.014	0.001	0.009	-0.044
	(0.027)	(0.029)	(0.031)	(0.031)	(0.028)	(0.030)	(0.029)	(0.028)	(0.027)
Almost always	0.015	0.021	-0.014	-0.016	-0.033	-0.005	0.004	-0.003	0.022
	(0.028)	(0.030)	(0.027)	(0.027)	(0.026)	(0.027)	(0.028)	(0.030)	(0.026)
Always	0.008	-0.011	0.021	0.023	0.053**	0.011	0.001	-0.004	0.025
	(0.028)	(0.026)	(0.027)	(0.027)	(0.027)	(0.027)	(0.025)	(0.023)	(0.029)

Notes: All the models are estimated using PISA 2015 and GDA 2009 data. The entries for each model are the coefficient and robust standard error in parentheses. The estimates control for students' gender and age at school entry, family immigration status, parental education, the number of books at home, the region of residence and the size of the community in which the school is located. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% significance levels. Following Feigenberg et al. (2023), and to avoid omitted variables bias when estimating interaction terms, we further control for the interaction between predetermined controls and the first principal component of the different teaching practices. Age at entry is standardized at the region level.