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## Relative age at school entry, school performance and long-term labor market outcomes

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## 1. Introduction

A universal cutoff date at school entry creates significant age differences within each cohort. If the cutoff is January 1st, and the age of school entry is five (six) years, children born in January are approximately 22 (20) percent older than children born in December. The earlier literature has shown that more mature students may perform better at school and initial maturity differences can have long-lasting effects on adulthood outcomes in the labor market due to the accumulation of human capital (see, e.g., Cascio and Lewis 2006; Dobkin and Ferreira 2010; Robertson 2011; Zweimuller 2013).

Bedard and Dhuey examined the impact of relative age on students' tests scores using the TIMSS data for 18 OECD countries. The scores of eighth-grade students revealed significant age effects. According to their estimates, one additional month of relative age increased the average math and sciences scores by 0.13 to 0.35 points, respectively. The study detected only two countries where such effects were not found: Finland and Denmark. One compelling explanation for the findings is that formal curriculum-based education starts later in these countries than in other countries. In particular, differentiation on the basis of ability is prohibited before the age of sixteen in Denmark, and in Finland, compulsory education starts at the age of seven, making initial age differences less apparent.

Bedard and Dhuey (2006) called for research on long-run differences in educational outcomes in countries with limited ability-differentiated learning groups in the primary grades. This paper answers this call by providing evidence on the relative age effects in the Finnish context. The setting is interesting because Finland is frequently ranked among the top performers in the Pisa rankings (see OECD 2012). Furthermore, Finland provides a useful case for an empirical analysis since the school entry rules are strictly followed. Thus, the total share of early (at the age of six) or delayed (at the age of eight) enrolments vary between one and two per cent in a cohort (EUCEA 2011).<sup>1</sup> The paper contributes to the literature by examining the connections between birth month and school success both at the sixth and ninth grades. We also examine the long-run relative age effects on educational attainment and labor market outcomes to study whether these results are consistent with the relative age effects on school performance.

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<sup>1</sup> It would be tempting to extend the analysis to those who enter school prior their formal age. This is, however, difficult for two reasons. First, such enrolments are rare, less than one per cent for each age cohort. Thus, these pupils are likely to be special in many unobservable ways (ability, strong parental involvement). This would impair statistical precision, and more importantly, produce biased estimates on the role of relative age on school performance.

## 2. Data and results

### 2.1 Data

This paper uses linked data that combines two data sources. The data on family background, birth month and school success, measured by the grade point average (GPA) at the sixth grade and ninth grade, are drawn from the Cardiovascular Young Finns Study (YFS). The study began in 1980 when a total of 3,596 persons in six age cohorts (aged 3, 6, 9, 12, 15 and 18) participated in the study. Since 1980, seven follow-up studies have been conducted, most recently in 2010/11. The GPA is based on self-reported information whereas the parental years of education and family's income level in 1979 (8 categories) were obtained by a questionnaire in 1980.

To obtain register-based information on educational attainment and long-term labor market outcomes, we linked the YFS to the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland using unique personal identifiers. As an indicator for educational achievement, we used the years of education based on the highest obtained degree in 2010 to ensure that educational investments are completed. Labor market outcomes are measured by the average years of employment and the logarithm of the average annual wage and salary earnings over the period of 2000-2010. The sample includes men and women aged 23-48 with the average age in 2000-2010 being 35.5 years.

### 2.2 Results

We first estimated the effect of relative age on GPA in the sixth grade by using indicator variables to compare the students born in (a) December vs. January, (b) 4th vs. 1st quarter, and (c) biannually. The baseline models control for gender and birth cohorts, which are both predetermined variables. Specifications vary across the length of the cutoff window, containing 317 to 1,852 students. To save space, we report the point estimates for pair comparisons (months, quarters and biannual) in one column.

We find that students born at the end of the year perform worse than their fellow students who were born earlier (Table 1, column 1). In particular, students born in December seem to perform worse than those born in January (see row 1). Similarly, the October-December cohort had lower scores than those born in January-March (see row 2). The results for biannual grouping reveal a similar pattern: the impact of relative age on GPA is negative and statistically significant (see row 3). It is possible that birth month reflects parental background, raising concerns about the omitted-variable biases and the causal interpretation of the results (Buckles and Hungerman 2013). This possibility is unlikely in our case because the results remain intact when controlling for family background (see column 2, rows 1-3). In sum, older children seem to have statistically significant but relatively small advantages over the younger ones within the same age cohort.

Columns 3 and 4 in Table 1 replicate the analysis for the ninth-grade students. All point estimates are statistically insignificant, implying that the relative age effect vanishes when the relative age difference decreases as students become older. This finding is in line with the results from the TIMSS data for eighth-grade students in Finland. From a broader perspective, our findings show that

although maturity may have some role in early school years, the effects are likely to dissipate as persons become older.

Table 2 reports the findings for the relationship between relative age and adulthood outcomes. We provide six sets of results for the years in formal education, earnings and employment. As above, specifications vary across the length of the cutoff window, containing 532 to 2,996 observations. The results show that there is a modest and statistically insignificant negative relationship between relative age and years in formal schooling. This finding applies to all comparison pairs (see columns 1-2). In sum, the results corroborate the findings for the test scores in the ninth grade: there is no relative age effect on educational attainment. The results on earnings in adulthood support this conclusion (see columns 3-4). There is no statistically significant relationship between average earnings, measured by earnings over the 2000-2010 period, and relative age at school entry. The results for average employment years over the 10-year observation window are again consistent with this view (see columns 5-6). Excluding the biannual comparison, the relationship between relative age and the average employment years is statistically insignificant.

### 3. Conclusions

We found a statistically significant relationship between relative age at school entry and school performance in the sixth grade but not in the ninth grade. The finding that advantages of maturity may be short-lived is supported by the results that relative age at school entry has no impact on the years in formal education, adulthood earnings or employment. Weak and in the long-run insignificant relative age effects reported in the paper are in accordance with the view emphasized in Bedard and Dhuey (2006): relative age effects should be modest in countries where curriculum-based education begins late (at the age of seven) and there are no ability-differentiated learning groups.

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Table 1. The impact of relative age at school entry on school success.

|  | 6 <sup>th</sup> grade |                      | 9 <sup>th</sup> grade |                   |
|--|-----------------------|----------------------|-----------------------|-------------------|
|  | (1)                   | (2)                  | (3)                   | (4)               |
| (1) Months:<br>January vs.<br>December | -0.215***<br>(0.077)  | -0.205***<br>(0.074) | -0.079<br>(0.098)     | -0.148<br>(0.093) |
| (2) Quarters:<br>Q1 vs. Q4             | -0.084**<br>(0.040)   | -0.085**<br>(0.037)  | -0.027<br>(0.050)     | -0.061<br>(0.047) |
| (3) Biannual:<br>H1 vs. H2             | -0.081**<br>(0.032)   | 0.064**<br>(0.031)   | -0.029<br>(0.041)     | -0.034<br>(0.039) |
| Family<br>background                   | No                    | Yes                  | No                    | Yes               |
| R <sup>2</sup>                         |                       |                      |                       |                   |
| Row 1                                  | 0.1653                | 0.2802               | 0.1102                | 0.2385            |
| Row 2                                  | 0.1290                | 0.2412               | 0.1006                | 0.2066            |
| Row 3                                  | 0.1178                | 0.2258               | 0.1084                | 0.2101            |
| No. of obs.                            |                       |                      |                       |                   |
| Row 1                                  | 317                   | 317                  | 327                   | 327               |
| Row 2                                  | 1244                  | 1244                 | 1207                  | 1207              |
| Row 3                                  | 1852                  | 1852                 | 1787                  | 1787              |

Note: Dependent variable is GPA at 6th and 9th grade. All specifications include gender and cohort indicators. Family background covariates consist of household's total income in 1979 and parental years of education. GPAs for the 6th grade were obtained from cohorts 1, 2, 3 and 4 in 1989, 1986, 1983 and 1980, respectively, and for the 9th grade, from cohorts 1, 2, 3, 4, and 5 in 1992, 1989, 1986, 1983 and 1980, respectively. Significant at \* 10%, \*\*5%, and \*\*\* 1% level. Heteroscedasticity-robust standard errors are reported in parentheses.

Table 2. Relative age at school entry and adulthood outcomes.

|   | (1)<br>Education<br>years | (2)<br>Education<br>years | (3)<br>Earnings  | (4)<br>Earnings  | (5)<br>Employment | (6)<br>Employment |
|---|---------------------------|---------------------------|------------------|------------------|-------------------|-------------------|
| (1) Months:<br>January vs.<br>December. | -0.127<br>(0.234)         | -0.105<br>(0.223)         | 0.056<br>(0.152) | 0.028<br>(0.150) | 0.003<br>(0.025)  | -0.001<br>(0.025) |
| (2)<br>Quarters:<br>Q1 vs. Q4           | -0.029<br>(0.123)         | -0.049<br>(0.671)         | 0.119<br>(0.082) | 0.123<br>(0.081) | 0.017<br>(0.013)  | 0.017<br>(0.013)  |
| (3)<br>Biannual:<br>H1 vs. H2           | -0.125<br>(0.101)         | -0.085<br>(0.096)         | 0.070<br>(0.066) | 0.077<br>(0.065) | 0.020*<br>(0.010) | 0.021<br>(0.010)  |
|   |                           |                           |                  |                  |                   |                   |
| Family<br>background                    | No                        | Yes                       | No               | Yes              | No                | Yes               |
| R <sup>2</sup>                          |                           |                           |                  |                  |                   |                   |
| Row 1                                   | 0.0425                    | 0.1597                    | 0.0068           | 0.0415           | 0.0246            | 0.0572            |
| Row 2                                   | 0.0367                    | 0.1572                    | 0.0095           | 0.0275           | 0.0237            | 0.0445            |
| Row 3                                   | 0.0370                    | 0.1510                    | 0.0107           | 0.0266           | 0.0269            | 0.0418            |
| No of obs.                              |                           |                           |                  |                  |                   |                   |
| Row 1                                   | 532                       | 532                       | 532              | 532              | 532               | 532               |
| Row 2                                   | 2019                      | 2019                      | 2019             | 2019             | 2019              | 2019              |
| Row 3                                   | 2996                      | 2996                      | 2996             | 2996             | 2996              | 2996              |

Note: Dependent variables are the years of formal education measured in 2010, log of average earnings and log of average employment years over the period 2000-2010. All specifications include gender and cohort indicators. Family background covariates consist of household's total income in 1979 and parental years of education. Significant at \* 10%, \*\*5%, and \*\*\* 1% levels. Heteroscedasticity-robust standard errors are reported in parentheses.