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Making Up for an Unlucky Month of Birth in School: Causal Evidence on the Compensatory Advantage of Family Background in England

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Abstract: Previous research has shown that being born in the months immediately preceding the school entry cut-off date leads to lower educational outcomes in countries with a strict admission policy. In this article we use the effect of age at school entry in England as an identification device to provide a causal estimate of the compensatory advantage enjoyed by children from high social origin families. We find that the negative effects of a young school entry age are stronger for children from low social origin families. We also investigate when social origin differences in school entry age effects emerge, and test possible mechanisms. We find that before starting school, a younger school entry age leads to lower test scores for children of both low and highly educated families. For children from highly educated families the negative effect, however, progressively declines over the school career and almost vanishes by age 16. With respect to the mechanisms underlying this compensatory effect, we find no strong mediating role for parental involvement in homework and private lessons or for school choice.

Keywords: causality; compensatory effect; educational inequalities; month of birth

In nearly all education systems, children enter school the year in which they reach a certain age before a given cut-off date. Since children are born in different months during the year, children in the same class might differ substantially in age at school entry. The youngest children in a class can be almost twelve months younger than the oldest, and previous research has shown that children who are younger upon entering school tend to have substantially worse educational outcomes (Bedard and Dhuey 2006; Black, Devereux, and Salvanes 2011; Crawford, Deardan, and Meghir 2010; Crawford, Deardan, and Greaves 2013; Dobkin and Ferreira 2010; Fredriksson and Öckert 2014; Mühlenweg and Puhani 2010).

Since postponement of school entry is not allowed in England, under the testable assumption that month of birth is not associated with family background, we use age at school entry as a randomly allocated characteristic and investigate whether its negative effect on education is smaller for children of high social origin families. This result is predicted by the compensatory advantage hypothesis, according to which an early disadvantage in education may persist or grow larger over the school career for children coming from low social origin families, while it is diminished for those who come from high social origin families (Bernardi 2014).

In addition, we investigate when the compensatory advantage enjoyed by children from a socioeconomically privileged background occurs. We are interested in finding out whether the compensation for a disadvantageous month of birth has already occurred before school start or whether it occurs later in the school career.

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Finally, we test three possible mechanisms underlying the compensatory advantage: private lessons, parental help with homework, and school choice.

We use data from two cohort studies in England: the Millennium Cohort Study (MCS) and the Longitudinal Study of Young People in England (LSYPE). These data allow us to measure educational performance at various points in a school career and to follow the evolution of social origin differences in school entry age effects over time.[1]

Heterogeneity of Month of Birth Effects and the Compensatory Advantage of Social Origin

Compensatory advantage describes the notion that children from socioeconomically advantaged families are more sheltered from the long-term consequences of prior disadvantageous events and characteristics that negatively influence educational attainment (Bernardi 2014; Bernardi and Cebolla-Boado 2014). An early disadvantage may persist or grow larger over the school career for children coming from low social origin families, but the same disadvantage may be less detrimental for the educational outcomes of children coming from high social origin families.

Two basic tenets in social stratification research suggest that a compensatory advantage is likely to be observed whenever a disadvantageous life event or individual characteristic endangers the chances of future educational and occupational achievement. First, families aim for their offspring to achieve at least their own social position (Boudon 1998; Breen and Goldthorpe 1997). In this respect, high social origin families have a stronger incentive to compensate for events and characteristics that endanger their children's future educational and occupational opportunities. Second, high social origin families have the financial, cultural, and social resources to pursue compensatory strategies. Based on the notion of compensatory advantage, our main hypothesis is that the negative implications of a young school entry age are concentrated among students from low social origin families.

So far causal evidence for such a compensatory advantage mainly comes from research on the effects of early health conditions on later educational and occupational outcomes. Almond and Mazumder (2013) provide a recent overview of this literature. Using exposure to radiation after the Chernobyl accident as a natural experiment, Almond, Edlund, and Palme (2009) show that the effects of early health shocks on later outcomes only persist in families with low educated fathers. Similarly, Torche and Echevarría (2011) show that the negative consequences of a low birth weight are largely concentrated in families with a low level of maternal education. In two similar but independent studies, Hsin (2012) and Restrepo (2012) study parental investment responses to birthweight differences between siblings growing up in the same families as a possible mechanism to explain these findings. Both studies come to the conclusion that families with a high level of parental education invest more in the disadvantaged sibling with a lower birth weight, but families with a low level of parental education invest more in the sibling who has a higher birth weight.

A second issue is the timing of when such a difference between social origin groups occurs. Studies of cognitive development in early childhood have consistently shown inequalities in cognitive skills before children enter school (e.g., Becker 2011). Following this line of research, one may expect that compensation for the month of birth penalty has already taken place before school entry. According to this line of thought, high social origin families are aware of and anticipate the potential disadvantage associated with an early school entry age. They make sure that their children are ready to start school despite their young age. However, an alternative explanation is that children from a high social origin who are born just before the cut-off date for admission to primary education may catch up later in the school career. This would be the case if, instead of compensating before school start, parents actively reacted to the low performance of their children once it became manifest in school, and took some course of action to address it.

Finally, in our study we are able to test two sets of explanations for how the compensatory advantage may be brought about. To start with, there may be parental actions directly oriented towards improving school performance. Examples of such actions are parents helping with homework or paying for additional private lessons (Coleman 1988). In addition, earlier research has shown that the sorting of children into different schools has a strong impact on educational inequalities (Ermisch and Del Bono 2012). Compensation of the disadvantage associated with a young age at school start might, then, occur as a result of social origin differences in school choice if high social origin families enroll their children in schools that are more effective in raising the performance of initially low-performing students.

The English Education System

Education is compulsory in England until age 16. Thereafter students and their families must decide whether to continue to take Advanced Level education (*A-levels*), which allows students to later pursue a university degree; to pursue a vocational degree; or to leave the education system. Before this decisive point in the English education system, performance is measured in centralized exams at certain ages. These exams are taken at the end of so-called Key Stages. In the analysis we employ scores at Key Stage 2 (age 11), Key Stage 3 (age 14), and Key Stage 4 (age 16). The exams at the end of Key Stage 4 are the most important ones, since they lead to the General Certificate of Secondary Education (GCSE) or equivalent qualifications. Grades range from A* to G, with A* being the highest and G the lowest. The achievement of five grades in the A* to C range is important for further educational attainment.

The cut-off date for admission to the first year of primary education (reception class) in England is the first of September. In most areas in England, children are admitted to reception class in September of the academic year in which they turn five (Crawford, Deardan, and Meghir 2010; Eurydice 2011). However, in other areas, pupils are admitted to reception class in the term in which they turn five. Children born between September and December are admitted in September, those born between January and March in January, and those born between April and August in April (Crawford, Deardan, and Meghir 2010). Under all circumstances, those born in August are the youngest in a school cohort, whether they start reception class in September or in a later term (January or April). In the latter case, they are even further disadvantaged by their month of birth because they receive less schooling. A key feature of the English education system for our research design is that, contrary to what happens in other countries, postponement of admission to the first year of primary education is not allowed by educational authorities (Eurydice 2011).

Research Design

In a recent article, Bernardi (2014) uses a regression discontinuity based on the school entry cut-off date in France and shows that French students born just before the cut-off date have a higher risk of grade retention than children born after the cut-off date. The risk is, however, much smaller for such students who are born to highly educated parents than for those from families with a low level of parental education. In this article, we employ a similar research design for the English case, although we consider different educational outcomes and mainly employ a linear definition of school entry age.

To develop our arguments more formally, one can consider a regression model that predicts the negative influence of a given event or characteristic C_i (such as low birth weight, birth order, parental separation, etc.) on an educational outcome:

$$E_i = C_i\beta + X_i\gamma + \varepsilon_i \tag{1}$$

with E_i being the educational outcome of interest and X_i being a vector of control variables. The error term is written as ε_i. The subscript i describes the individual.

If we are now interested in heterogeneity by social origin, we add an interaction with an indicator of social origin to the model:

$$E_i = C_i\beta + SO_i\delta + C_i \times SO_i\zeta + X_i\gamma + \varepsilon_i. \tag{2}$$

The interaction between C_i and SO_i tells how the association between a disadvantageous characteristic and an educational outcome varies with family background.

The endogeneity of C_i makes a causal interpretation of the parameters of Equation (2) problematic. If some unobserved variables affect both the disadvantageous characteristic C_i and the educational outcome E_i, both the estimate of β and the estimate of the interaction effect ζ are biased and inconsistent. In order to test the compensatory advantage hypothesis causally, the disadvantageous C_i must be exogenous. We argue that starting school at a young age in England (as in other countries with a strict cut-off date for admission) is such an exogenous disadvantageous trait. The model that will be estimated can, then, be written as:

$$E_i = A_i\beta + SO_i\delta + A_i \times SO_i\zeta + X_i\gamma + \varepsilon_i \tag{3}$$

with A_i being a continuous variable of school entry age, depending on the birth month relative to the school cut-off date. If A_i is truly exogenous, the interaction effect $A_i \times SO_i$ can be causally interpreted. Alternatively, A_i can be constructed as a dummy variable that distinguishes those born in August, just before the cut-off date, and those born in September, just after it. In this second specification, model 3 becomes a regression discontinuity (Dobkin and Ferreira 2010).

The causal interpretation of the school entry age effect depends crucially on whether month of birth is randomly distributed across the population. We will therefore start our empirical analysis precisely by testing this assumption. Before doing that we describe in the next section the data, variables, and models that we use.

Data, Variables, and Models

Data

We use data from two English cohort studies: the Millennium Cohort Study (MCS) (University of London 2010) and the Longitudinal Study of Young People in England (LSYPE) (Department for Education and National Centre for Social Research 2011). These survey datasets are representative of two English cohorts of children, with the LSYPE using a sample of children born around ten years earlier than the children in the MCS. However, due to restrictions in the educational outcomes available in the datasets, we use the MCS to cover the earlier years and the LSYPE to cover the later years of the children's school career.

The MCS samples children who were born in 2000 and 2001. We restrict the sample to children born between September 2000 and August 2001 in order to have one cohort of children who entered school in the same academic year. We use information from the first three waves of the MCS.

The LSYPE samples children who were aged 13 to 14 in 2004 and follows them with yearly updates in seven waves until 2010. The survey started with an initial sample size of 15,770 participating pupils in 2004. The survey samples children attending both maintained and independent schools. Again, we restrict the sample to children born within one academic year cohort; in the case of this survey, between September 1989 and August 1990. The LSYPE data includes information on school grades from the National Pupil Database, allowing us to use information on school grades for these pupils at ages 11, 14, and 16.

We restrict both samples to children who were in England at the time of the survey, and the LSYPE sample to children born in the UK.

Variables

The central independent variable in our analysis is relative age at school start (abbreviated as relative age in the tables). The variable is coded so that being born in the month immediately before the cut-off date (August) is equal to 0, while being born in September is equal to -11. This means that children who are younger upon entering school (those born in August) are given a higher value for this variable. Its coefficient can, therefore, be interpreted as the penalty of a younger school entry age. In addition to this linear specification, as a robustness check we consider age at school start as a categorical variable and compare those born in the months just before and after the cut-off date. The results are fully in line with those obtained using the linear school entry age variable.

We define social origin by the highest level of education achieved by a child's father or mother. The variable is coded dichotomously, with a high level of parental education meaning that one of the parents has obtained A Level, an equivalent, or a higher qualification. Based on these definitions, between 44 percent (MCS) and 47 percent (LSYPE) of the children sampled have parents with a high level of education (see Table 1).

We analyze the effect of relative age on different measures of cognitive performance and educational outcomes. The following outcomes are estimated as dependent variables in regression models (the data source used to estimate the specific outcome is in parentheses):

- British Ability Scores at age five (MCS)
- Key Stage 2 scores at age 11 (LSYPE)
- Key Stage 3 scores at age 14 (LSYPE)
- Achievement of at least five GCSE (and equivalents) at grades between A* and C at age 16 (LSYPE)
- Decision to continue with academically oriented education after age 16 (LSYPE)

Performance at Key Stages 2 and 3, as well as performance on the GCSE, is measured for all pupils at about the same time, but performance in the MCS is measured by tests taken in the third wave when the children were about age five, and the tests were not taken by all children on the same day. The fieldwork conducted during the third wave of the MCS took place between September and May 2006. Children born in September were interviewed at the beginning of the fieldwork period and those born in August toward its end. However, since the fieldwork period was shorter than the time frame in which the children were born apart, the children born in August were, on average, younger than children born in September when the survey test was administered. For each month a respondent was born later in the academic year, on average, he or she was about 21 days younger when the survey test was taken. Because of this fieldwork design, some respondents were younger at the time of the test solely because of their month of birth. We argue that for that reason, the fieldwork design operates like a cut-off date for admission to school. It should be noted, however, that we are likely to underestimate the month of birth penalty at age five. The age difference, due to month of birth, for national tests taken on the same day at ages 11, 14, and 16 is larger than the age differences at the time of the survey at age five. If the month of birth penalty is smaller, it should be easier for children from highly educated families to catch up. The analysis at age five using the MCS therefore provides a conservative test of the hypothesis that the compensatory advantage enjoyed by children of highly educated families is already in place before starting school.

The MCS assessment at age five includes three standardized tests measured by the British Ability Score. We report the results for the Vocabulary score in the main text and the results for the Picture Similarity and the Pattern Construction Scores in

Table 1: Descriptive Statistics

	Millennium Cohort Study (MCS)			Longitudinal Study of Young People in England (LSYPE)		
	Mean	Std. Dev.	*N*	Mean	Std. Dev.	*N*
Relative age	−5.53	3.47	9,277	−5.38	3.47	13,953
Male	0.51	0.50	9,277	0.51	0.50	13,823
High parental education	0.44	0.50	9,252	0.47	0.50	13,918
British ability score, vocabulary age 5†	106.30	17.03	9,117			
KS2 score†				26.99	4.02	13,221
KS3 score†				33.83	6.59	13,178
5 GCSE at grades A* to C				0.60	0.49	13,625
Academic education after 16				0.73	0.45	9,519
Private lessons				0.23	0.42	13,921
Help with homework				0.86	0.34	13,579

Source: Millennium Cohort Study (MCS), Longitudinal Study of Young People in England (LSYPE).
† We report means and standard deviations on these variables before standardization. In the models we, however, regress on these variables after standardization.

the appendix. There are no differences in results between the three test scores. We standardize these outcome variables with a mean of 0 and a standard deviation of 1 so that effects of the independent variables can be interpreted in terms of standard deviations.

At Key Stage 2 (age 11) and Key Stage 3 (age 14), performance is measured in Mathematics, English, and Science via standardized tests. At both Key Stages we employ an overall performance score as an average of these test scores. Test results come close to being normally distributed. These outcome variables are also standardized with a mean of 0 and a standard deviation of 1.

At Key Stage 4 (age 16), performance refers to the GCSE (and equivalent) exams. As a summary measure of performance on the GCSE exams we consider whether someone achieved a grade between A* and C in at least five GCSE (or equivalent qualifications). In the supplement we show results for achieving A* to C in English and Mathematics. Finally, we investigate whether or not the respondents decide to continue with academic education after age 16. About 60 percent of students achieve five or more GCSE (or equivalents) with grades of A* to C, and about 73 percent continue with academic education (Table 1).

With regard to the mechanisms that possibly underlie the observed compensatory advantage, we use information provided by the parents on whether they paid for private lessons. At each wave of the LSYPE, parents report whether they have paid for their children to have extra lessons in the past twelve months. We use the first four waves of the LSYPE, which cover the phase between ages 13 and 16, to construct a dummy variable valued at 1 if parents report that they paid for their son or daughter to have any extra lessons within the time period covered by the four survey waves. A similar dummy variable is constructed with respect to homework, with pupils reporting whether they had any support at home in completing their homework. This information was included in the first two waves of the LSYPE, which covers the period between ages 13 and 14. Thus, help with homework is a dummy variable coded 1 if students report that they received support at home for completing their homework at age 13 or 14.

The role played by school choice in providing compensation to students with a young school entry age and highly educated parents is tested through comparison of the month of birth penalty within and between schools. We apply school-fixed effects models and compare the results of these models to the results of the cross-sectional estimates. School-fixed effects models use only the variation within schools by comparing pupils who attend the same school (Ermisch and Del Bono 2012). We argue that a reduction in the school entry age effect in the school-fixed effects models would mean that the selection of school, which is influenced by family background, plays a role in explaining the compensatory advantage to students from highly educated families.

Models

We estimate OLS regression models for test scores and Linear Probability Models (LPMs) for the achievement of five GCSE with grades A* to C and for the decision to continue with academically oriented education after age 16. We use LPMs in the latter case because of the straightforward interpretation of their estimates, in particular the interaction effects which we focus on in our analysis (Angrist and Pischke 2009; Mood 2010). For all our estimates we present ten percent significance levels based on one-tailed tests because we have a clear hypothesis for both the direction of the school entry age effect and the compensatory effect (Freedman, Pisani, and Purves 2007). Commenting on the findings, we concentrate on effect sizes.

Results

The Association between Month of Birth and Social Origin

We start by analyzing the association between month of birth and parental education in England. Buckles and Hungerman (2013) found that families from different social origins in the United States tend to give birth to children in different seasons of the year. The crucial assumption of our research design is, however, that there is no systematic sorting of birth dates by social origin in the months before and after the school entry cut-off date (i.e., before and after September 1). Previous studies conducted in England suggest that this assumption is valid (Crawford, Deardan, and Meghir 2010; Crawford, Deardan, and Greaves 2014). Nor do we find any sizeable differences by educational status in the propensity to give birth in a given month (Table 2).

The chi-square tests for the association between parental education and month of birth are statistically insignificant, and the Cramér's V measures of association are almost equal to zero in both the MCS and the LSYPE samples. It should be noted that our samples are large enough to detect any substantively large effects.[2]

Table 2: Percentage of Children Born in Each Month by Parental Education

	Millennium Cohort Study (MCS) Relative Age (Month of birth)											
	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
Parental education	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Low	8.69	8.34	8.23	9.31	8.61	7.15	7.98	8.23	8.23	8.92	8.21	8.09
High	8.52	8.39	8.86	8.24	7.85	7.26	9.11	8.02	8.59	8.71	8.27	8.17

$N = 9,252$.
Pearson χ^2 (11) = 9.7380 (Pr = 0.554)
Cramér's V = 0.0324

	Longitudinal Study of Young People in England (LSYPE) Relative Age (Month of birth)											
	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
Parental education	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Low	7.92	8.34	8.08	7.82	8.09	7.93	8.47	7.93	8.97	8.57	9.08	8.81
High	8.04	8.24	7.72	8.29	7.85	8.29	8.35	8.01	8.75	8.87	8.76	8.81

$N = 13,916$.
Pearson χ^2 (11) = 3.4657 (Pr = 0.983)
Cramér's V = 0.0158

Based on these results we conclude that there is no association between month of birth and parental education. This finding supports our strategy of interpreting month of birth as an exogenous explanatory variable.

Variation in the Effects of School Entry Age on Educational Outcomes

Table 3 reports regression models of the effects of age at school entry on educational outcomes and their variation by social origin.

The first model for each educational outcome documents the effects of school entry age at different stages of the school career. In line with previous research, we find that being born in August instead of September entails a sizeable penalty in terms of educational achievement. For instance at age five, being one month younger leads to a 0.035 standard deviations lower vocabulary score on the British Ability Score. This result means that being born in August instead of September reduces the Vocabulary score by 0.385 standard deviations.

The month of birth penalty decreases between Key Stage 2 and Key Stage 3 but is still sizeable at the GCSE exams at age 16. Model 7 shows that the likelihood of receiving at least five GCSE (or equivalents) with grades between A* and C is about seven percentage points ($11 \times -0.006 = -6.6$ percent) lower for children born in August than for children born in September. The disadvantage based on month of birth is thus not trivial, and it is similar in size to gender inequality in educational outcomes, which has received substantial attention in recent research (Buchmann and DiPrete 2006). What is more, there is also a month of birth penalty

Table 3: The Effects of Relative Age at School Entry and Social Origin on Cognitive and Educational Outcomes at Different Ages

	BAS Vocabulary at age 5 (MCS)		KS2 Score at age 11 (LSYPE)		KS3 Score at age 14 (LSYPE)		5 GCSE at Grades A* to C at Age 16 (LSYPE)		Academic ed. after age 16 (LSYPE)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Relative Age	−0.035*	−0.037*	−0.034*	−0.038*	−0.022*	−0.026*	−0.006*	−0.010*	−0.004*	−0.006*
	(0.003)	(0.004)	(0.002)	(0.004)	(0.003)	(0.004)	(0.001)	(0.002)	(0.001)	(0.002)
High parental education	0.545*	0.572*	0.579*	0.621*	0.666*	0.711*	0.272*	0.309*	0.207*	0.232*
	(0.020)	(0.038)	(0.022)	(0.034)	(0.023)	(0.035)	(0.010)	(0.017)	(0.011)	(0.019)
Relative age X High parental education		0.005		0.008*		0.008*		0.007*		0.005*
		(0.006)		(0.005)		(0.005)		(0.003)		(0.003)
Male	−0.056*	−0.056*	−0.070*	−0.070*	−0.101*	−0.101*	−0.078*	−0.078*	−0.021*	−0.021*
	(0.020)	(0.020)	(0.022)	(0.022)	(0.024)	(0.024)	(0.010)	(0.010)	(0.011)	(0.011)
N	9,093	9,093	13,077	13,077	13,032	13,032	13,473	13,473	9,454	9,454

Notes: Models are estimated using data from the Millennium Cohort Study (MCS) and the Longitudinal Study of Young People in England (LSYPE). (1) to (6) are OLS regression models with standardized outcome variables. (7) to (10) are Linear Probability Models with binary outcome variables. Standard errors in parentheses.
Significance level (one-tailed tests): $* \ p < 0.10$.

for the decision to pursue further academically oriented qualifications, as model 9 demonstrates.

The second set of models investigates whether the effect of relative age varies by parental education at different ages. Model 2 shows that having highly educated parents does not mitigate in any sizable way the disadvantage of an unlucky month of birth before starting school. In contrast, at ages 11 and 14 there are hints that a compensatory advantage starts to manifest itself. In fact, the interaction between parental education and relative age is positive and becomes more sizeable over time. It is, however, at age 16 that the compensatory advantage becomes fully evident. For someone whose parents are not highly educated, being born in August implies a penalty of eleven percentage points ($11 \times -0.010 = -11$ percent) in the probability of achieving at least five GCSE with grades of A* to C, when compared to someone born in September. For those whose parents are highly educated, the same penalty is only three percentage points ($11 \times -0.010 + 11 \times 0.007 = -3.3$ percent).

Overall the findings presented in Table 3 lend support to the hypothesis that the compensatory advantage increases over time and is actually strongest at the educational stage that is most consequential for final educational attainment, taking the GCSE (or equivalent) exams and deciding whether to continue with an academically oriented education at age 16.

Testing the Mechanisms Bringing About the Compensatory Advantage

Next, we test three possible mechanisms that could be causing the compensatory advantage of students from highly educated families: private lessons, parental help with homework, and school choice. Estimates in Table 4 refer to the results on the GCSEs at age 16.

First, we look at the role of private lessons. Taking private lessons has a positive impact on educational performance, but this impact does not vary with the relative age at which a child enters school. Furthermore, once one adds private lessons and the interaction between private lessons and relative age to the model, the coefficient for the interaction between parental education and relative age does not vary. If highly educated parents use private lessons to help their children who were born in August to compensate for their initial disadvantage, we should expect a larger reduction in the size of the interaction effect between relative age and parental education. We conclude that private lessons do not bring about the observed compensatory effect.

Second, we look at the role parental help with homework plays in compensating for a disadvantageous month of birth. Help with homework is positively associated with all four measures of educational performance at age 16. However, since the size of the interaction between relative age and parental education does not decrease once we control for help with homework in the models, we also conclude that help with homework does not underlie the compensatory advantage of children of highly educated parents.

Third, we test for the influence of school choice. Table 4 reports the results of the LPMs with and without school-fixed effects. In line with the estimates in Ermisch

Table 4: The Effects of Relative Age at School Entry and Social Origin on Educational Outcomes and the Mediating Role of Mechanisms

	5 A* to C in GCSE, Age 16							
							OLS Regression	School Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Relative Age	−0.010*	−0.010*	−0.010*	−0.011*	−0.011*	−0.011*	−0.006*	−0.006*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.001)	(0.001)
High Parental Education	0.311*	0.281*	0.280*	0.307*	0.303*	0.303*	0.272*	0.174*
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.010)	(0.008)
RelativeAge X High Parental Education	0.007*	0.007*	0.007*	0.008*	0.008*	0.008*		
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)		
Male	−0.078*	−0.071*	−0.071*	−0.073*	−0.071*	−0.071*	−0.078*	−0.094*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)
Private Lessons		0.176*	0.184*					
		(0.011)	(0.018)					
Relative age X Private Lessons			0.001					
			(0.003)					
Homework					0.063*	0.066*		
					(0.013)	(0.025)		
Relative age X Homework						0.000		
						(0.004)		
N	13,447	13,447	13,447	13,447	13,447	13,447	13,447	13,447

Notes: Models are estimated using data from the Longitudinal Study of Young People in England (LSYPE). Standard errors in parentheses. Significance level (one-tailed tests): $* \; p < 0.10$.

and Del Bono (2012), the effect of parental education is reduced by more than one third in the school-fixed effects models. This finding suggests that a large part of the observed family background inequality in educational outcomes is mediated by school choice. The coefficient of the relative age effect, however, does not change. This result implies that the disadvantage associated with a young age at school start persists within schools. This means that the processes commonly subsumed under the label of school effects, such as the quality of the school, the socioeconomic composition of peers, and quality of teachers, apparently do not play a role in reducing the month of birth penalty.

Robustness Checks

We conducted several robustness checks in order to ensure that the substantive conclusions of this paper hold under different specifications. At each educational stage we used several different outcome measures: we have two other cognitive tests available at age 5; we have considered the results for Mathematics, Science, and English at Key Stages 2 and 3 separately, as well as for Mathematics and English at Key Stage 4. At Key Stage 4 we have also used the total number of GCSE with grades A* to C. The findings of these additional analyses are fully in line with those that we presented above and can be found in the supplementary material.

In addition, we estimated our models only for those students born just before and just after the discontinuity created by the cut-off date for admission into primary school. We construct a dummy that equals 1 for children born between June and August and 0 for children born between September and November. The children born in other months are dropped from the analysis. The results of this alternative specification are fully in line with the results presented here (see supplementary material).

Conclusion and Discussion

In this paper, we have provided evidence that a young school entry age in England, a country with strict rules for admission to primary education, entails a long-lasting disadvantage for educational attainment. We have also shown, however, that a young age at school start has less harmful consequences for those with highly educated parents. In their case, the month of birth penalty accounts for a reduction of three percentage points in the probability that a child achieves at least five GCSE (and equivalents) with grades between A* and C, a key achievement for later enrollment at a university. For children of parents with low education, the month of birth penalty rises to eleven percentage points. We interpret these findings as causal evidence of a more general compensatory advantage enjoyed by children of highly educated parents (Bernardi 2014).

In addition, we have shown that the compensatory advantage for those with highly educated parents is not in place before school starts but that it emerges later in the educational career. It actually becomes strongest when the first important transition in the English educational system takes place.

These results lead to the question of how the compensatory advantage comes about. Although we have not been able to provide a satisfactory answer to this question, we can at least exclude some of the "usual suspects." Our findings show that help with homework, contracting private tutors, and school choice do not explain the observed compensatory advantage. However, several other mechanisms that we have not been able to test may be at play. Insights, in this respect, can come from the economic literature on birth endowments and parental responses to them (Almond and Mazumder 2013). In this area, the key question is whether parents reinforce or reduce initial differences in endowments between their children (see also Conley 2004).

Classic work in sociology of education on teachers' expectations and labeling may also explain how initially disadvantaged children from highly educated families catch up with their peers, while similarly disadvantaged children from low-educated families become trapped in a trajectory of low achievement (Hargreaves, Hester, and Mellor 1975; Jussim and Harber 2005). Since children from disadvantaged families are more often subject to negative teacher labeling, an initial low achievement linked to month of birth is likely to be more harmful for their future educational outcomes.

Throughout this paper we have argued that month of birth provides a unique opportunity for the causal identification of compensatory advantage in those countries with strict school admission rules. We have also shown that the penalty associated with an unlucky month of birth is comparable in size to the much-discussed gender inequality. In order to test how common the phenomenon of a compensatory effect is, further research could employ causal identification strategies to test whether a compensatory advantage is observed for other individual or family characteristics that are associated with a disadvantage in educational outcomes, such as birth order and parental separation.

Notes

1 In this article we do not discuss the mechanisms underlying the effect of school entry age on educational outcomes. See Crawford, Deardan, and Greaves (2014) for an extensive discussion of the main drivers of the month of birth penalty. For our identification strategy it is enough that a young age at school entry is negatively associated with educational outcomes, and that it is not associated with family background.

2 A sensitivity analysis shows that with our current sample size, fixing alpha at 0.10 would allow us to depict a Cohen's W equal to 0.04 in the MCS ($n = 9{,}252$) and equal to 0.03 in the LSYPE ($n = 13{,}916$), with a power equal to 0.80 (Faul et al. 2009).

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