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Original Article

Double Disadvantage in School? Children of Immigrants and the Relative Age Effect: A Regression Discontinuity Design Based on the Month of Birth

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Abstract

This article uses pupil's month of birth as a natural experiment to study how immigrant-native inequalities in retention rates are produced. We argue that, compared to native-born parents, immigrant parents face additional disadvantage when dealing with the age disadvantage of their children. We test this hypothesis using a regression discontinuity design with the French sample of the Programme for International Student Assessment. We find that pupils born before the cut-off date for entering primary school are 9 percentage points more likely to repeat a grade in primary school. In line with the double disadvantage hypothesis, the relative age effect is 10 percentage points higher for children with two immigrant parents, while we do not find a difference for children with one immigrant parent. However, the relative age effect is reduced to 4 percentage points when adjusting for the differential effect of parental resources, suggesting that part of the disadvantage is due to compositional differences in socio-economic background and part is immigrant-specific.

Introduction

Ample research concludes that, compared to their native peers, immigrant children are disadvantaged in educational outcomes (Vallet and Caille, 1996; Glick and White, 2003; Heath, Rothon and Kilpi, 2008; Alba, Sloan and Sperling, 2011). Differences between natives and immigrant children are already present in early education (Duru-Bellat, 2002; Biedinger, Becker and Rohling, 2008). These disadvantages might have 'lock-in' effects because pupils who did not start learning on the same level as others subsequently fall behind (Heckman, 2006). Indeed, early disadvantages translate into higher retention rates for immigrant children, especially in primary education (Caille and Rosenwald, 2006; Tillman, Guo and Harris, 2006; Brinbaum and Kieffer, 2009; Park and Sandefur, 2010).

'Lock-in' effects are often referred to as *cumulative (dis-)advantage* or *the Matthew effect*: once an individual is disadvantaged, the disadvantage will grow over time (Merton, 1968; Dannefer, 2003; DiPrete and Eirich, 2006). 'Lock-in' effects also vary by parental socio-economic status, a phenomenon that has been labelled 'compensatory

advantage' (Bernardi, 2014): university-educated parents are better able to mobilize resources to alleviate their children's schooling difficulties. However, while research finds that educational inequalities between immigrant and native pupils are largely explained by socio-economic inequalities (Tillman, Guo and Harris, 2006; Brinbaum and Cebolla-Boado, 2007; Heath and Brinbaum, 2007; Ichou and van Zanten, 2014), we know little about the extent to which educational inequalities are produced within primary education.

This article contributes to the existing literature in two ways. First, we use the month of birth as a natural experiment to study the retention risk of children of immigrant parents relative to that of French-born parents. Gaps in retention rates may be the consequence of (unobserved) disadvantages that have been accumulated at earlier stages in the life course and at different rates for different individuals (cf. Duru-Bellat, 2002). Only partly taking into account previously accumulated disadvantages might result in biased estimates due to unobserved heterogeneity. When school admission laws are exclusively based on a pupil's birthday, the 'relative age effect' refers to the finding that children born shortly before the cut-off date are the youngest in their grade, cognitively less developed, and, as a result, are disadvantaged in educational outcomes (Florin, Cosnefroy and Guimard, 2004; Bedard and Dhuey, 2006; Ponzo and Scoppa, 2014). Because the month of birth is randomly distributed, the effect is not biased by previously accumulated disadvantage. The relative age effect solely emerges conditional on a strict school cut-off date. While a disadvantage that exists before entering school may affect educational outcomes as well, the relative age effect quantifies an inequality that was produced *within* compulsory schooling. Hence, heterogeneities of the relative age effect with regard to parental immigration background can only have been produced since school admission (Bernardi, 2014).

Second, the article adds to the understanding of how the grade retention risk may differ across social groups. Building on the compensatory disadvantage mechanism put forward by Bernardi (2014), we analyse whether a 'lock-in effect' occurs for children of immigrants, which we label 'double disadvantage'. Immigrant parents might be less proficient in the destination country's language, possess less knowledge about the educational system, or lack cultural and social capital to navigate it. Therefore, once immigrant children fall behind, they will have more trouble catching up again than their peers without an immigrant background. Thus, the aim of this study is to test whether immigrant children suffer from 'double disadvantage'.

To test our hypotheses, we make use of the French sample of the *Programme for International Student Assessment* (PISA). PISA offers information on pupil's grade retention and their parental background and is frequently used to study immigrant inequalities in education (Marks, 2005; Levels, Dronkers and Kraaykamp, 2008). Furthermore, the data are publicly available and extensively documented; it is thus easily accessible for replication.

The article proceeds as follows. First, we give a short overview of the French education system and its immigrant population[1]. We then discuss cumulative disadvantage theory. Subsequently, different reasons for an inhibited ability of disadvantage compensation of immigrant parents are considered. The method section is arranged to guide the reader through the regression discontinuity (RD) design, a method still rarely used in sociology. The article concludes with the presentation of the results and their discussion.

The Case of France

Primary Education

In France, compulsory education starts with primary education (école élémentaire). Children start school in September of the year that they turn 6 (Eurydice, 2011). Admission is based on a strict age-based policy. That is, all pupils born in the same calendar year start school in September of the year they turn 6. Hence, the cut-off date for school admission is the first of January, making children born in December the youngest in their school entrance cohort. The entrance rule is strict and not subject to the influence of parents ('redshirting').[2] Such a strict cut-off date is ideal for the correct estimation of the relative age effect (Bernardi, 2014; Bernardi and Grätz, 2015). We study grade retention in primary school which is common practice in France: at the age of 15 years, in 2009, about one-third of pupils had repeated a grade at least once. Even though retention rates have dropped considerably (by 16 percentage points from 2009 to 2015), they are still among the highest in the Organisation for Economic Co-operation and Development (OECD) countries (Eurydice, 2011; OECD, 2016).

While grade retention is the main 'correction mechanism' for poor performance and developmental challenges of pupils, attitudes towards it are mixed. While many pupils deem it a second chance, some also see it as demotivating (CNESCO, 2015). Children of immigrant parents are even less positive of grade retention. The decision-making process is not based on objective performance criteria and has been criticized for being subjective (Mons and Heim, 2014). Consequently, attitudes

are also mixed about whether retention decisions were justified. Parents can appeal a school's recommendation for grade retention within 15 days (Eurydice, 2011).

The effects of grade retention for society are rather clear. It is costly, in terms of per-pupil spending, as well as for the individual, in terms of foregone and lower earnings (Brodaty, Gary-Bobo and Prieto, 2008; Goos *et al.*, 2013; Schwerdt, Winters and West, 2017). The effect of grade retention on educational success is less clear. Some evidence suggests that repeaters are less likely to obtaining a diploma (Brinbaum, Moguerou and Primon, 2012), have lower literacy levels (Brinbaum and Kieffer, 2009), and show lower self-esteem (Dutrévis and Crahay, 2013). Yet, there is also evidence that shows that grade retention, at least for those who have repeated only once, can be a helpful correction mechanism (Mahjoub, 2017).

Ethnic Minority Population

The French migrant population largely reflects its colonial history and its strong ties to Southern European countries. France has long been a major destination of migration in Europe. In 2010, the share of 18–20-year-old pupils with at least one immigrant parent was 17 per cent (INSEE, 2010). About 11 per cent of the population are descendants of immigrants (6.5 million people). Southern European countries are the largest origin group (39 per cent has at least one parent from Portugal, Spain, or Italy), followed by the North African countries (35 per cent from Algeria, Morocco, or Tunisia). Total 9 per cent of the second generation come from other EU-27 countries, 4 per cent from sub-Saharan Africa, and 13 per cent from other countries. For the younger cohorts, the distributions are skewed towards non-European ancestry.

In terms of educational outcomes, immigrants in France aspire higher educational levels than their native peers (Vallet and Caille, 1996). Yet, educational attainment is often lower for immigrants, although this difference is mostly explained by the socio-economic status of the parents (Vallet and Caille, 1996; Brinbaum and Cebolla-Boado, 2007). Controlling for these background measures, and also school grades, one also finds that immigrant pupils are more likely to be sorted into the academic track and pass the *baccalauréat* (Vallet and Caille, 2000; Brinbaum and Cebolla-Boado, 2007).

The Cumulative Nature of Education

Learning is a cumulative process. As Heckman (2000) puts it: 'early learning begets later learning and early success breeds later success, just as early failure breeds later failure'. Yet, learning is more than the mere accumulation of knowledge. Accumulated knowledge also results in inequalities among high- and low-performing pupils (Aunola *et al.*, 2004; Bodovski and Farkas, 2007). This pattern is predicted by cumulative (dis-)advantage theory; (dis-)advantages that emerged in the life course persist and grow at increasing rates (DiPrete and Eirich, 2006).

Cumulative (dis-)advantage theory is rooted in the seminal concept of the 'Matthew Effect', first coined by Merton (1968). The Matthew effect is often captured in sayings like 'the rich get richer, and the poor get poorer'. Cumulative (dis-)advantage refers to a systemic tendency of inter-individual divergence in a given characteristic over one's lifespan (here, grade retention) (Dannefer, 2003). This implies that cumulative (dis-)advantage is a not a property of individuals but of differences between individuals and populations (here, children from immigrant and native-born parents) (Dannefer, 2003). Systemic tendency means that (dis-)advantages are not a simple extrapolation from a point of origin but are subject to the interaction of several forces (here, parental compensation) (Dannefer, 2003). Because the potential for compensation of accumulated (dis-)advantage varies within the population, the interaction of these forces can be considered as a breeding ground for social inequalities (Bernardi, 2014; Bernardi and Grätz, 2015).

Due to unobserved heterogeneity, studying accumulated (dis-)advantage in educational performance is not easy. Because it is impossible (not least unethical) to randomly distribute disadvantages among school children, scholars rely on natural experiments. Such exogenous shocks ranging from radioactive fallout (Almond, Edlund and Palme, 2009) to educational policies (Angrist and Krueger, 1992; Angrist and Lavy, 1999; Bernardi, 2014; Bernardi and Grätz, 2015) affect educational outcomes and are distributed randomly across pupils (for a review on natural experiments in education research, see Webbink, 2005).

The month of birth too can be used as a natural experiment to study educational disadvantage. Numerous educational systems are set-up in a way that causes some pupils to start school at a much younger age than others while still being in the same grade. Pupils who were born 'too late' to enter school must wait until the next year to start. When pupils eventually start school 1 year later, they are older and more 'ready' to learn. When school admission laws are exclusively based on a pupil's birthday, the 'relative age effect' refers to the finding that children born shortly before the cut-off date are the youngest in their grade, as a result have less developed cognitive skills and are therefore disadvantaged in educational outcomes (Bedard and Dhuey, 2006; Ponzo and Scoppa, 2014). It

might also be the case that different forms of self-fulfilling prophecies regarding self-expectations (Galatea effect) and teacher expectations (Pygmalion effect) drive the relative age effect (see also Hancock *et al.*, 2013).

The empirical evidence for the existence of a relative age effect in educational performance is abundant. The youngest pupils score lower in standardized tests (Bedard and Dhuey, 2006; Ponzo and Scoppa, 2014), are more likely to repeat a grade (Elder and Lubotsky, 2009; Dobkin and Ferreira, 2010), less likely to continue to higher education (Crawford, Dearden and Meghir, 2010), and less likely to attend prestigious universities (Matta *et al.*, 2016). Because the month of birth is randomly distributed, the relative age effect is not biased by previously accumulated disadvantage. The 'exogenous shock' of being relatively young can thus be interpreted as disadvantage that is created during schooling.

Immigrants' Disadvantage in Education

It is likely that, compared to native-born parents, immigrant parents are less able to compensate for the educational problems of their children. As a consequence, we expect the exogenous shock of being 'relatively young' to be more harmful for children of immigrants than for children of native-born parents.

The first argument for immigrants' double disadvantage is compositional: some scholars argue that parental socio-economic and cultural resources explain the educational gap between immigrants and natives (Vallet and Caille, 1996; Kao and Thompson, 2003; Marks, 2005; Brinbaum and Cebolla-Boado, 2007; Rothon, 2007; Heath, Rothon and Kilpi, 2008; Levels and Dronkers, 2008). In Western Europe, immigrants are over-represented in society's socio-economically weaker strata (Heath, Rothon and Kilpi, 2008). Effectively maintained inequality theory predicts that high-status parents mobilize all available resources to secure the successful educational advancement of their children (Lucas, 2001; Bernardi, 2014). The influence of parental socio-economic status on educational outcomes is widely researched (Erikson *et al.*, 2005). Because these resources correlate with immigrant origin, it is likely that immigrant parents are less able to compensate for the educational performance of their children.

In addition to socio-economic resources, cultural resources influence educational outcomes (Aschaffenburg and Maas, 1997; Sullivan, 2001; Van De Werfhorst and Hofstede, 2007; Jæger, 2011). Cultural capital refers to aesthetic preferences and styles of interaction and behaviour such as, for example, children attending art classes, and parents playing music at home, going to museums, or encouraging the child to read. There is evidence that immigrant parents have fewer of such resources (Kraaykamp, Notten and Bekhuis, 2015). Therefore, immigrant parents are less well equipped to compensate for the educational performance of their children.

Consequently, we expect that immigrant children are more negatively affected when exposed to an exogenous shock, like being relatively young. We thus formulate our first hypothesis:

Hypothesis 1. The negative effect of being relatively young on grade retention is larger for children of immigrants than for children with native-born parents.

The second reason why the relative age effect may be more detrimental for children of immigrants is specific to immigrants. Immigrant parents may lack the necessary language skills to support their children in education (Van De Werfhorst and Van Tubergen, 2007). Poor language skills may also impede parent–teacher contact (Wong and Hughes, 2006; Crozier and Davies, 2007).

Furthermore, parents who were not educated in the destination country's education system may lack the personal experience necessary to navigate their children through education (Pfeffer, 2008). This so-called *strategic knowledge* has been shown to be an important factor in explaining the immigrant-native achievement gap (Van De Werfhorst and Van Tubergen, 2007). Different norms towards teachers as authority figures may further discourage parents from getting involved (De Gaetano, 2007). To cite an example, Bangladeshi and Pakistani parents in England reported a sense of 'trust' in the authorities to ensure their children's advancement through school and that teachers would contact the parents whenever issues arise, and not the other way around (Crozier and Davies, 2007). Considering that in France, parents not only have to object but *argue* against grade repetition, immigrant parents might be less able to make such a case.

Hence, immigrant parents are less able to compensate for poor educational performance of their children due to poor language proficiency, a lack of strategic knowledge, and different norms and expectations that inhibit parents' ability to compensate for their children's problems at school. We formulate thus our second hypothesis:

Hypothesis 2. The negative effect of being relatively young on grade retention is larger for children of immigrants than for children with native-born parents, also when controlling for the educational, economic, and cultural background of the parents.

There may be a competing argument, however. The literature on the secondary effects paradox consistently

Table 1. Descriptive statistics

Variable	*N*	Mean/percentage	SD	Minimum	Maximum
Grade retention (repeated at least once)	11,903	11.79	–	0	1
Relative age					
Young	11,903	52.07	–	0	1
Immigration background					
Both parents born in France	11,903	78.76	–	0	1
One immigrant parent	11,903	11.99	–	0	1
Two immigrant parents	11,903	9.25	–	0	1
Language at home (French)	11,699	94.89	–	0	1
Gender (male)	11,903	47.30	–	0	1
Parental education					
Lower secondary and primary	11,903	7.69	–	0	1
Vocational	11,903	16.68	–	0	1
Upper secondary	11,903	18.63	–	0	1
University	11,903	56.99	–	0	1
Home possessions (*z*-scores)					
Educational resources	11,896	0	1	−4.89	1.59
Wealth possessions	11,896	0	1	−4.45	5.27
Cultural possessions	11,354	0	1	−1.58	2.55
Parental occupation (*z*-scores)	11,354	0	1	−2.02	1.91
ESCS (*z*-scores)	11,903	0	1	−4.48	3.93

Source: PISA 2009, 2012, 2015.

finds higher educational aspirations among children of immigrant parents (Brinbaum and Cebolla-Boado, 2007; Jonsson and Rudolphi, 2011). High educational aspirations may imply that immigrant parents are more motivated then native-born parents to overcome a disadvantage such as the relative age effect. As a consequence, the relative age effect may be smaller for children of immigrants compared to the native-born.

Data and Method[3]

Data

To test the hypotheses, the French data from the 2009, 2012, and 2015 surveys of the OECD PISA were pooled. PISA is a cross-sectional survey to measure pupils' problem-solving skills at the end of compulsory schooling. In most countries, compulsory schooling ends at around the age of 15 years. Therefore, pupils who participate in PISA are between 15 years and 3 months and 16 years and 3 months old. Pupils fill out a 30-minute background questionnaire about themselves, their parents, their situation at home, and their experiences in school (OECD, 2014, 2017). PISA also contains detailed measures of parental resources, for example, relating to wealth and cultural capital (OECD, 2014, 2017). The sampling frame of PISA consists of two stages. First, a minimum of 150 schools per country are randomly selected to participate. At least 4,500 pupils per country are then randomly selected from within selected schools.[4] This age-based sampling is ideal for the estimation of the relative age effect. For example, in a grade-based sampling one would not be able to study retention rates of pupils who started school in the same year.

Our analytic sample includes all observations with valid data on the month of birth, the grade pupils were in when taking part in PISA, their immigration background, and the socio-economic status of the parents. Pupils who advanced to a grade higher than the modal grade[5] were excluded. Finally, following Bernardi (2014), we excluded pupils in special education because the strict admission rule used to identify the relative age does not apply to them (2.23 per cent). The remaining sample consists of 11,903 pupils. Table 1 shows the descriptive statistics.

Measurement

Retention. The dependent variable is a dichotomous variable indicating whether a student has repeated a grade at least once during primary school. The information is self-reported.

Young. The variable 'Young' distinguishes pupils born before the cut-off date (1st January) from pupils born after it: it has the value 1 for pupils born in the 6

months before the cut-off date (July–December) and 0 for pupils born in the 6 months after it (January–June).

Immigration background. We distinguish minority and majority individuals based on the country of birth of the individual and the parents. We include only individuals who are born in France, as the first generation may have attended school elsewhere, which results in a different school starting age. Research suggests that regarding school achievement, children of one immigrant parent are different from both natives and children with two immigrant parents (Kalmijn, 2015). Regarding educational outcomes, they were either found to be more similar to immigrants (Levels, Dronkers and Kraaykamp, 2008) or more similar to natives (Azzolini and Barone, 2013). Therefore, we distinguish between children with both parents born in the origin country, children with one parent born in the origin country, and children with both native parents. Pupils reported this information to the question: 'In what country were you and your parents born?' (see OECD, 2017). Unfortunately, the PISA data do not allow differentiation in specific countries of birth other than 'France' versus 'other'. In the discussion, we come back to this issue.

Parental resources. *Highest parental education* is provided by PISA. Pupils reported this information to four questions, two per parent: 'What is the highest level of schooling completed by your mother/father' and 'Does your mother/father have any of the following qualifications?' (see OECD, 2017). The standard PISA variable refers to the highest education of either mother or father and is based on the International Standard Classification of Education (ISCED)-97 scheme. We recode this information into 'Lower secondary and primary education', 'Vocational education', 'Upper secondary education', and 'University education'. The *highest parental occupation* was reported by the pupils to four questions: 'What is your mother's/father's main job? (e.g. school teacher, kitchen-hand, sales manager) and 'What does your mother/father do in her main job? (e.g. teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team)'. The occupation codes were converted into the international socio-economic index of occupational status (ISEI) (Ganzeboom and Treiman, 2003). *Household possessions* are measured by asking the pupil 'Which of the following are in your home?' and presenting pupils a list of items (see OECD, 2017). Based on these items, PISA provides validated scales that capture *wealth possessions*, *cultural possessions*, and *home educational resources*. For example, indicators of *wealth* include 'A room of your own', number of rooms with a bath or shower, number of television, number of cars, and number of computers. Examples of indicators of educational resources include 'A desk to study at', 'A quiet place to study', or educational books/software. *Cultural possessions* indicate whether the pupil has books at home and works of classical literature, poetry, art, music, or design, as well as musical instruments. The *index of economic, social, and cultural status (ESCS)* is a composite measure of the parental education, parental occupation, and home possessions as provided by PISA (OECD, 2014). Because the design of the variable changed over the different cycles of PISA, the OECD offers a harmonized version on their website. We use this harmonized version in all our estimates. Last, we include the *language spoken at home* (French versus Other) as a proxy for French language proficiency. We standardize all measures on the sample mean.

The Regression Discontinuity Design

Modelling compensation of disadvantage in an educational setting is not a straightforward task (Bernardi, 2014). This is due to the fundamental problem of causal inference that one can never observe the same individual in two different states at the same time (Holland, 1986). When employing a conventional regression design and adding control variables, unobserved factors are not accounted for. Therefore, disadvantage is modelled as a RD design based on the school admission cut-off date and the student's birth month.

The advantage of the RD design is that endogeneity due to previously accumulated disadvantage is no longer problematic. In the context of education, the birth month acts as the assignment variable for receiving the treatment of being among the youngest in a school entry cohort. The causal effect of relative age on schooling outcomes can thus be studied (Bernardi, 2014). Given that the month of birth is random, the only reason for differences in cognitive development and educational outcomes is the difference in relative age.

Some caveats of this strategy have to be addressed. First, its effects on the child's development might be too weak to be distinguishable (Bound, Jaeger and Baker, 1995). If that would be the case, then there would be no discontinuity around the cut-off (Bernardi, 2014). Figure 1 shows that there indeed is a considerable discontinuity in retention rates. Second, the month of birth may vary with the socio-economic status of the parents; children born in winter are more likely to have mothers who are unmarried, in their teenage years, or without high school diplomas (Buckles and Hungerman, 2013). Parents thus may have some level of control regarding the month or season of birth. It seems questionable, however, to what extent this control is precise enough

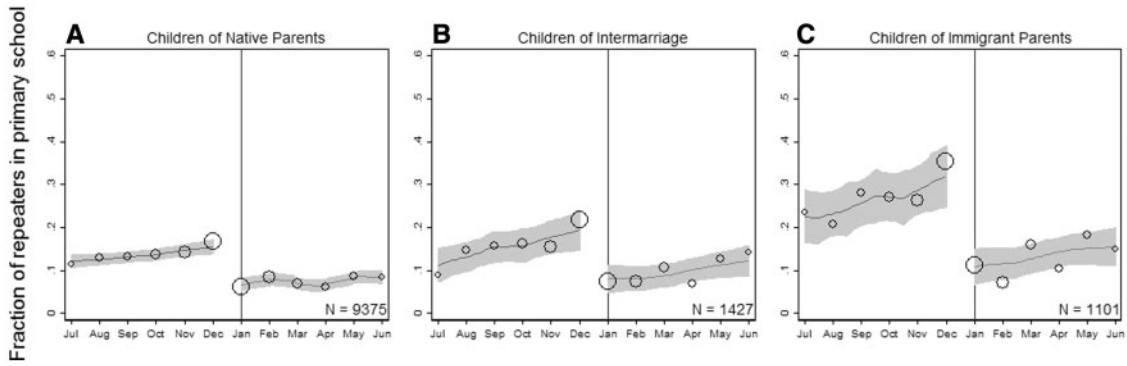

Figure 1. Fraction of pupils that repeated a grade at least once during primary school; plotted by distance of birth month to school admission cut-off date (1st January)

Note: Grey area visualizes the 95 per cent confidence interval; bubble size represents the inverse distance weights.

Source: PISA 2009, 2012, 2015.

Table 2. Month of birth by parental education and immigration background

Birth month	Parental education					Immigration background			
	Lower secondary or less	Vocational	Upper secondary	University	Total	Native	One immigrant parent	Two immigrant parents	Total
January	72	159	172	480	883	698	95	90	883
February	71	152	143	511	877	697	110	70	877
March	69	168	172	491	900	696	104	100	900
April	60	157	199	568	984	782	115	87	984
May	86	170	173	598	1,027	821	102	104	1,027
June	81	152	221	579	1,033	804	128	101	1,033
July	77	207	197	582	1,063	828	137	98	1,063
August	85	166	205	621	1,077	844	137	96	1,077
September	65	163	176	612	1,016	812	122	82	1,016
October	75	166	186	579	1,006	794	112	100	1,006
November	88	165	176	567	996	782	123	91	996
December	87	161	197	596	1,041	817	142	82	1,041
Total	916	1,986	2,217	6,784	11,903	9,375	1,427	1,101	11,903
	Pearson chi^2 (33) = 40.11, $P = 0.184$					Pearson chi^2 (22) = 21.98, $P = 0.461$			

Source: PISA 2009, 2012, 2015.

when it comes to consecutive months not least days of the same season. Table 2 presents cross-tabulations and tests of independence by birth month and both parental education and immigration background. We conclude that the month of birth is not related to parental education and migration status.

An important assumption of the RD design is the monotonicity assumption. It requires that the treatment affects all treated individuals in the same way (Barua and Lang, 2016). In countries where a child can be held back for a year before entering school ('redshirting'), the month of birth as the assignment variable is likely to violate the monotonicity assumption. That is, if a student born shortly before the cut-off point has been held back for a year, she was the oldest instead of the youngest in her cohort. In this case, 'redshirting' and not the month of birth determines relative age. This is not an issue in countries with a strict admission policy, like France, where the month of birth is the only determinant of school starting age (Bernardi, 2014).

Our estimation strategy is thus as follows. To predict grade retention, we estimate linear probability models (Mood, 2010). Our treatment variable is 'being young'. To reduce seasonal bias and to correct for the general age trend in retention risk, we follow the estimation strategy proposed by Machin, Marie, and Vujić (2011) and weight the observations by their inverse distance to the cut-off date, such that individuals born closer to the cut-off date are weighted more heavily than individuals born later or earlier. Another advantage of inverse distance weighting is that we do not have to choose an observation window for the RD design, a choice which is often being criticized for being relatively arbitrary (Imbens and Kalyanaraman, 2012). Another advantage of inverse distance weighting is that it works well with discrete assignment variables such as being young. In the robustness checks section, we estimate alternative specifications, including an age trend and varying the time window around the cut-off date.

We furthermore include migration background and gender, and we control for the PISA cycle. Usually, because the treatment is random, no controls are necessary in an RD design. However, to give the reader an anchor point to compare the effect sizes we include gender (cf. Bernardi, 2014). To test our first hypothesis, we estimate the interaction term migrant * young. In a second step, we estimate this model while controlling for the parental resources. In a series of robustness checks, we estimate alternative specifications. In the 'Results' section, we discuss the results of the sensitivity checks; we report the estimates in the Online Appendix.

Results

Bivariate Results: RD Graphs

Figure 1 displays RD graphs that show the fraction of repeaters relative to birth months for retention in primary school. In each graph, the horizontal axis shows the month of birth relative to the cut-off date. The vertical line indicates the cut-off date, which is 1st January. Left of the dashed line, children are younger, whereas to the right of it, children are older. Children born in January are 11 months older than children born in December. The gap between both trend lines at the cut-off is the relative age effect: pupils who were born just before the cut-off date have repeated a grade more often compared to pupils born just after the cut-off date.

Multivariate Analysis

In Tables 3–5, we present the multivariate analysis. All models apply the inverse distance weights (Machin, Marie and Vujić, 2011; see also estimation strategy above). As a result, observations closer to the cut-off date are weighted more heavily, herewith correcting for the age trend associated with grade retention that we observe in the data (Figure 1). The variable 'Young' contrasts pupils born in the second half of the year with pupils born the first half of the year.

Model 1 shows that for young pupils, the probability of having repeated at least one grade during primary school is 9 percentage points higher than for relatively older pupils. Model 2 adds the immigration background. We see that children born to immigrant parents and children born to one immigrant parent have an overall higher risk of grade retention of 3 and 10 percentage points, respectively. To test our first hypothesis, Model 3 adds the interaction term immigration background * young. The main effect of 'Young' should now be interpreted as the age penalty for pupils born to native parents. These pupils have an 8 percentage point higher probability to have repeated a grade than their relatively older peers. The main effect of immigration background should now be interpreted as the higher probability to repeat for relatively older pupils with two immigrant parents. The significant interaction term estimates the additional penalty for relatively young pupils with immigrant parents. As predicted by *Hypothesis 1*, compared to pupils with native parents, children of immigrant parents are disadvantaged with a 10 percentage point higher probability of having repeated a grade. Model 3 also shows that the age penalty does not differ between children with one immigrant parent and children with native parents. Apparently, children with one immigrant parent are more similar to children with two French-born parents in this regard (cf. Kalmijn, 2015).

To test our second hypothesis, in Table 4, we additionally control for parental resources (Model 4a). For both natives and children of immigrants, the relative age effect is slightly lower when controlling for parental resources: it is 7 percentage points for natives with an additional penalty of 8 percentage points for children of immigrants. In line with our expectations, the relative age penalty for children of immigrant parents remains statistically significant. However, Model 4a does not allow the effect of parental resources to be different for 'young' and 'old' children. As Bernardi (2014) shows, parents of high socio-economic status (SES) partly compensate for the disadvantage of being relatively young. In Model 4b, we allow for this mechanism by including an interaction term between parental resources and the treatment variable ('being young'). The main effect of 'young' is bigger in this model because it now refers to the relative age penalty for children with lower educated

Table 3. RD models predicting grade retention in primary school

	Model 1		Model 2		Model 3	
	b	se	*b*	se	*b*	se
Relative age (ref. cat.: Old)						
Young	0.09**	0.01	0.09**	0.01	0.08**	0.01
Immigration background (ref. cat.: Both parents born in France)						
One immigrant parent			0.03**	0.01	0.02	0.01
Two immigrant parents			0.10**	0.01	0.05**	0.01
Relative age * immigration background						
Young * one immigrant parent					0.01	0.02
Young * two immigrant parents					0.10**	0.02
Control variables						
Gender (ref. cat.: Female)						
Male	0.02**	0.01	0.02**	0.01	0.02**	0.01
PISA cycle (ref. cat.: 2009)						
2012	−0.01	0.01	−0.01*	0.01	−0.01*	0.01
2015	−0.06**	0.01	−0.06**	0.01	−0.06**	0.01
Constant	0.10**	0.01	0.09**	0.01	0.09**	0.01
Observations	11,903		11,903		11,903	
R^2	0.025		0.033		0.035	

Notes: $^{**}p < 0.05$; $^{*}p < 0.10$, two-sided tests; observations are inverse distance weighted from cut-off date following (Machin, Marie and Vujić, 2011).

parents and average resources, supporting the argument put forward in (Bernardi, 2014). Model 4b shows that the relative age effect is still significantly larger for children with two immigrants parents, compared to children of native parents. However, its coefficient reduces to a 5 percentage point difference with the native born. A substantial part of immigrants' relative age effect can thus be explained by the different use of resources of parents of young versus old children.

While Table 4 accounts for an extensive battery of parental resources, plus its differential effect for young and old children, it does not account for potentially differential effects of resources for immigrant parents versus native parents. When faced with a disadvantage (being young), immigrant parents may use their resources differently than native-born parents. For that reason, in Table 5, we additionally interact parental resources with immigrant status and with being young. Because adding a three-way interaction with each separate resource implies adding 37 interaction terms, we make use of the combined parental resource variable that PISA provides: ESCS (see measurement). In Model 5, we replicate Model 4b, now using the ESCS variable, instead of resources separately. At 5 percentage points, the immigrants' relative age effect is the same in size. We also observe that the interaction of being young * ESCS is statistically significant. In other words, also in our data, there is a compensatory advantage effect of high socio-economic status parents (cf. Bernardi, 2014).

In Model 6, we allow the effect of parental resources to vary for immigrant and native parents. The relative age effect is reduced to 4 percentage points, albeit at $p < 0.10$. The results suggest that immigrant parents may indeed use resources differently. As predicted by *Hypothesis 2*, also when considering parental socio-economic and cultural resources, children of immigrant parents are more negatively affected by a late birth month: children of immigrant parents have a 4 percentage point higher probability of having repeated a grade at least once. However, the interaction coefficient 'Young * Children with two immigrant parents' reduces substantially when accounting for differences in parental resources. We come back to this in the discussion.

We carried out several robustness checks, all of which are reported in the Online Appendix. First, we present alternative specifications to the RD design, none of which substantially changes our findings: in Online Table A1, we include a linear age trend plus its interaction with immigration background; in Online Table A2, we vary the width of the time window (1, 2, and 3 months). With 14 percentage points, the effect size of the relative age effect in this specification is the same as in Bernardi (2014). Our preferred specification has a lower effect size because we compare two halves of a year. Online Table A3 presents a model using only the distance to the cut-off in months as variable of interest. Last, the inverse distance weighing technique that we

Table 4. RD models predicting grade retention in primary school while controlling for parental resources

	Model 4a		Model 4b	
	b	se	*b*	se
Relative age (ref. cat.: Old)				
Young	0.07**	0.01	0.09**	0.02
Immigration background (ref. cat.: Both parents born in France)				
One immigrant parent	0.04**	0.01	0.04**	0.01
Two immigrant parents	−0.00	0.02	0.01	0.02
Relative age * immigration background				
Young * one immigrant parent	−0.02	0.02	−0.01	0.02
Young * two immigrant parents	0.08**	0.02	0.05**	0.02
Parental resources				
Family wealth possessions	−0.00	0.00	0.00	0.00
Cultural possessions	−0.03**	0.00	−0.02**	0.00
Highest parental occupational status (ISEI)	−0.05**	0.00	−0.03**	0.00
Home educational resource	−0.01**	0.00	−0.01**	0.00
Parental education (ref. cat.: Lower secondary and primary education)				
Vocational	−0.08**	0.01	−0.07**	0.02
Upper secondary	−0.10**	0.01	−0.09**	0.02
University	−0.10**	0.01	−0.09**	0.02
Language spoken at home (ref. cat.: French)				
Non-French language spoken at home	−0.00	0.01	−0.01	0.02
Relative age * parental resources				
Young * family wealth possessions			−0.01	0.01
Young * cultural possessions			−0.02**	0.01
Young * highest parental occupational status (ISEI)			−0.03**	0.00
Young * home educational resource			−0.00	0.01
Relative age * parental education (ref. cat.: Lower secondary and primary education)				
Young * vocational			−0.02	0.03
Young * upper secondary			−0.02	0.03
Young * university			−0.01	0.02
Young * non-French language spoken at home			0.03	0.03
Control variables				
Gender (ref. cat.: Female)				
Male	0.02**	0.01	0.01**	0.01
PISA cycle (ref. cat.: 2009)				
2012	0.01*	0.01	0.01*	0.01
2015	−0.03**	0.01	−0.03**	0.01
Constant	0.16**	0.01	0.15**	0.02
Observations	11,173		11,173	
R^2	0.094		0.100	

Notes: $^{**}p < 0.05$; $^{*}p < 0.10$, two-sided tests'; observations are inverse-distance weighted from cut-off date following (Machin, Marie and Vujić (2011).

apply does not allow inclusion of population weights. Using different specifications, Online Table A4 presents estimates that include the PISA balanced repeated replication weights.

Furthermore, given the large over-time decrease in retention risk, the relative age effect may vary over time. In Online Table A5, we show that the results are robust to including interaction terms with the PISA cycle. Last, it has been argued that the effect of parental resources may be non-linear: Online Table A6 contains quadratic terms for parental recourses. The substantial results do not change.

Conclusions and Discussion

This study tested how a randomly distributed disadvantage in the form of a late birth month affects the risk of grade repetition of 15-year-old pupils in France. To study this educational inequality, school admission

Table 5. RD models predicting grade retention in primary school, controlling for parental resources and its differential effects for young compared to old, and natives as compared to children of immigrants

	Model 5		Model 6	
	b	se	*B*	se
Relative age (ref. cat.: Old)				
Young	0.08**	0.01	0.08**	0.01
Immigration background (ref. cat.: Both parents born in France)				
One immigrant parent	0.03**	0.01	0.03**	0.01
Two immigrant parents	0.01	0.01	0.02	0.02
ESCS	−0.06**	0.00	−0.06**	0.00
Interaction terms				
Young * ESCS	−0.04**	0.01	−0.04**	0.01
Relative age * immigration background				
Young * one immigrant parent	0.00	0.02	−0.00	0.02
Young * two immigrant parents	0.05**	0.02	0.04*	0.02
Immigration background * ESCS				
One immigrant parent * ESCS			−0.01	0.01
Two immigrant parents * ESCS			0.02*	0.01
Three-way interaction				
Young * one immigrant parent * ESCS			0.03*	0.02
Young * two immigrant parents * ESCS			−0.02	0.02
Control variables				
Gender (ref. cat.: Female)				
Male	0.02**	0.01	0.02**	0.01
PISA cycle (ref. cat.: 2009)				
2012	0.00	0.01	0.00	0.01
2015	−0.05**	0.01	−0.05**	0.01
Constant	0.08**	0.01	0.08**	0.01
Observations	11,903		11,903	
R^2	0.098		0.099	

Notes: $^{**}p < 0.05$; $^{*}p < 0.10$, two-sided tests; observations are inverse-distance weighted from cut-off date following (Machin, Marie and Vujić (2011).

procedures in France were exploited as a natural experiment. The findings show that pupils who are relatively young are 9 percentage points more likely to have repeated a grade in primary school.

The main question of this study was whether such an exogenous shock has more adverse consequences for the grade retention risk of children with an immigration background compared to children without an immigration background. Compared to children with native-born parents, children with two immigrant parents who are born in an 'unlucky' month were 10 percentage points more likely to repeat at least one grade in primary school. This effect size is substantial and considerably larger than the often-discussed gender difference (see also Bernardi, 2014).

However, the findings also show that the difference in the probability of grade retention between relatively young immigrant and native-born children reduces when controlling for parental socio-economic and cultural resources. That is, the presented evidence suggests that, in line with previous research on immigrants' educational inequalities (Tillman, Guo and Harris, 2006; Brinbaum and Cebolla-Boado, 2007; Heath and Brinbaum, 2007; Ichou and van Zanten, 2014), the relative age effect is for a large part explained by parental socio-economic and cultural resources.

However, the findings also suggest that there is a disadvantage specific for children of two immigrant parents: when accounting for parental resources *and* its differential use by immigrant parents, a penalty of 4 percentage points remains. While previous research has documented the existence of compensatory advantage of high-status parents (Bernardi, 2014), this study provides evidence of an immigrant-specific, and thus 'double disadvantage'. This suggests that while at school, both socio-economic and immigrant-specific inequalities are produced.

Several limitations of the present study should be acknowledged. Given our research aim we especially

focused on identifying an immigrant-specific disadvantage. While we document that such disadvantages are produced while at school, we could not directly test the operating mechanisms. Partly, immigrant's double disadvantage can be explained by the differential effect of the parental resources: compared to French-born parents, immigrant parents may be less able to effectively use their resources. Future research may be aimed at disentangling the mechanisms we proposed, such as parent–teacher contact, and lobbying as well as teacher expectations (one example is Crawford, Dearden, and Greaves, 2014), or educational aspirations. Future research ventures might also focus on potentially biased teacher expectations of immigrant and native pupils (Van den Bergh *et al.*, 2010). Relative age might not be a salient characteristic to teachers. Teachers might therefore ascribe low performance of relatively young immigrant children not their age, but to their immigration background.

Furthermore, while we controlled extensively for parental resources, there may be relevant unobserved resources too. To the extent that such unobserved resources correlate both with immigrant status and with being young, this affects the size of the relative age effect. Yet, this does not necessarily mean that the relative age effect is smaller. For example, when educational aspirations could be accounted for, due to the higher educational aspirations of immigrant parents (Brinbaum and Cebolla-Boado, 2007; Jonsson and Rudolphi, 2011), the relative age effect of children with immigrant parents likely becomes larger.

Another limitation of this study is that we could not distinguish between origin countries. This is a limitation of most studies using French data, which are subject to the republican 'color-blind approach to social reality' (Lorcerie, 1994; Ichou and van Zanten, 2014). However, not being able to exclude 'Western' immigrant also means, that in the current study the disadvantage for 'non-Western' immigrants was possibly underestimated, as former are regarded to be less disadvantaged and sometimes advantaged compared to natives (Heath, Rothon and Kilpi, 2008).

The external validity of the current findings is limited to countries with a strict school admission. While in France there is little possibility of parental intervention at school entrance ('redshirting'), in other countries this is common practice. To facilitate cross-national comparisons of the relative age effect, future research could adjust for parental manipulation of the school admission time point. If handled accordingly, more countries (those with less strict admission policies) could be analysed, for example by means of a fuzzy design (Fredriksson and Öckert, 2014).

Future studies on what we have labelled 'double disadvantage' should also take into account the community environments, for example, by following the strategies proposed by Levels, Dronkers, and Kraaykamp (2008) and Van Tubergen, Maas, and Flap (2004) as well as school characteristics (Kristen, 2008; Dronkers, van der Velden and Dunne, 2012; Dronkers and Van der Velden, 2013; Dronkers, Levels and de Heus, 2014). Multiple points of view on the issue of immigrant disadvantages in education could help researchers to understand and tackle the emergence of inequalities. In the light of recent migration and refugee flows in Europe, those insights might be more valuable than ever.

Notes

1 A detailed review of the literature on immigrant children in the French education system can be found in Ichou and van Zanten (2014).
2 Even though France has a strict policy, there were 132 (1.11 per cent) students who were in a lower than modal grade without reporting to have ever repeated a grade. We performed robustness checks (see Table A7 in the appendix).
3 For replication purposes, all do-files will be made available on the websites of the authors.
4 For detailed information on the sampling and the data, see the PISA Technical Report (OECD 2014). PISA has strict rules on minimum response rates from both schools and pupils, and for these the reader is referred to the PISA technical reports and other PISA-related manuals.
5 The modal grade for 15-year-old pupils is Grade 10; pupils in higher grades were excluded from analysis (3.88 per cent).

Supplementary Data

Supplementary data are available at *ESR* online.

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