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Compensatory Advantage as a Mechanism of Educational Inequality: A Regression Discontinuity Based on Month of Birth

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Abstract

Compensatory advantage is a mechanism of social stratification that complements cumulative advantage and path dependence. In this article, I first discuss the theoretical foundations of the compensatory advantage and path dependence mechanisms and the methodological challenges that complicate identification of their effects. Next, I present a practical demonstration of the use of the compensatory advantage theoretical framework, with a regression discontinuity design estimating the probability of being continuously promoted throughout primary education in France. Results indicate that students born just before the cutoff date for primary school entry, who are consequently the youngest in the class when starting school, face a larger risk of grade repetition. In line with theoretical predictions of the compensatory advantage model, the risk is much smaller for students born to highly educated parents compared to students whose parents have lower educational attainment.

Keywords

compensatory advantage, regression discontinuity, month of birth, cumulative advantage, path dependency

INTRODUCTION

In this article I discuss the notion of compensatory advantage as a stratifying mechanism that complements those of cumulative advantage and path dependence. The concept of cumulative advantage is often applied to the study of social inequality. The underlying idea is that the current level of accumulation of a given resource, such as cognitive abilities, educational performance, income, or health, directly affects its future level. An initial advantage in access to a particular resource thus tends to grow over time (DiPrete and Eirich 2006). The notion of cumulative advantage is closely related to the idea of path dependence in life course trajectories, and the concepts are often used interchangeably. Path dependency in the context of a life course means life course trajectories become "locked in" by some critical preceding condition. Research shows, for instance, that placement on a particular educational path largely determines final educational outcomes (Kerckhoff 1993; Kerckhoff, Haney, and Glennie 2001). In summary, the common idea at the core of both the cumulative advantage and path dependence

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mechanisms is that an initial state at time t causally conditions later outcomes at times t + 1.

The central insight of the concept of compensatory advantage is that life course trajectories of individuals from privileged backgrounds are less dependent on prior negative outcomes. An early disadvantage is likely to persist or grow larger over time for people from disadvantaged families, whereas it is likely to attenuate for those from more advantaged families. In other words, the compensatory advantage mechanism predicts that patterns of cumulative disadvantage and unfavorable path dependence are less prevalent among upper-class students.

The notion of compensatory advantage, or conceptually similar ideas, has been used in previous research (Boudon 1998). What is novel here is that I provide a presentation of the formal properties and theoretical bases of the compensatory advantage mechanism for the specific case of educational inequalities. Moreover, I highlight the problem of identifying a true causal compensatory effect, which has been notoriously hard to establish because the assignment to the initial state at time t, which affects later outcomes at time t + 1, does not occur randomly. As DiPrete and Eirich (2006) note in discussing cumulative advantage models, consistent estimation of such models is complicated by the lagged value of the outcome variable being endogenous. The same problem applies to estimation of compensatory advantage models.

In the second part of the article, I apply the concept of compensatory advantage to a study of educational inequality. The dependent variable is the probability of successful promotion after every grade in primary education in France. This is an important educational outcome because a large share, about 20 percent, of French children have to repeat a grade and fail to complete primary education on time. Evidence shows that grade repetition has long-term scarring effects on educational and occupational attainment and thus has important implications for social stratification (Gary-Bobo and Robin 2013).

To tackle the endogeneity intrinsic to compensatory advantage models, I use a regression discontinuity (RD) design based on the cutoff date for admission to primary education and respondent's birth month. I consider being born in the months just before or after the cutoff date to be a random trait that affects the chances of being continuously promoted through primary education in France. I then test the following hypotheses: First, both upper- and lower-class students should have a greater risk of being held back when they are the youngest in their school entrance cohort. Second, in line with predictions of the compensatory advantage model, the relative penalty associated with younger age should be lower for upper-class compared to lower-class students.

THE COMPENSATORY ADVANTAGE MODEL

Formal Considerations

One can conceive of two educational outcomes at time t and t + 1. For the sake of simplicity, we can discuss the problem in dichotomous terms. The outcome can be either a success (S) or a failure (F). Social background distinguishes two groups: the socioeconomically advantaged upper class (U) and the socioeconomically disadvantaged lower class (L).

The core idea of compensatory advantage is that for the upper class, a failure at time t, instead of a success at time t, entails lesser negative consequences for the prospects of success at time t + 1, compared to the lower class. Put another way, chances of success at t + 1 are more dependent on the previous outcome at time t for the working class than for the upper class. Formally, this idea can be expressed with the following inequality:

$$P(S_{t+1}|S_t)L - P(S_{t+1}|F_t)L > P(S_{t+1}|S_t)U - P(S_{t+1}|F_t)U. \tag{1}$$

Inequality 1 can be rewritten as follows:

$$P(S_{t+1}|F_t)U - P(S_{t+1}|F_t)L > P(S_{t+1}|S_t)U - P(S_{t+1}|S_t)L. \tag{2}$$

Inequality 2 shows that if compensatory advantage is at play, social background inequality should be larger among individuals who failed at time t, compared to those who were successful.[1] Inequality 2 also suggests that the notion of compensatory advantage refers to a more specific scenario than the following inequality:

$$P(S_{t+1}|F_t)U - P(S_{t+1}|F_t)L > 0. \qquad (3)$$

In other words, evidence of an upper-class advantage for succeeding at time t + 1 among those who failed at t, as expressed by Inequality 3, is not sufficient to invoke a compensatory advantage. Inequality 3 might simply derive from the general advantage the upper class U enjoys over the lower class L, both in previous failures and successes. On the other hand, Inequality 2, which follows from the definition of compensatory advantage, conveys the central idea that in case of a failure at time t, the upper class U enjoys a specific additional advantage that minimizes negative consequences for success at time t + 1.

Theoretical Considerations

I discuss the theoretical foundations of compensatory advantage in reference to early childhood educational outcomes, but the main arguments developed here can extend to other outcomes and processes, including non-educational outcomes. Patterns of compensatory advantage described by Inequalities 1 and 2 can be brought about by different reactions of the upper and lower classes to a previous negative outcome in school at time t (Conley 2008). On the one hand, the upper class might invest more resources to compensate for their children's early failure. On the other, the lower class might invest less and divert their scarce resources to other children in the family. The two scenarios are not incompatible and might be true at the same time.

Stratification theories provide a microlevel explanation in terms of goals and resources for why families of different social standing might react differently to their children's early negative school outcomes. A key tenant of relative risk aversion (RRA) theory is that educational choices are driven by the goal of avoiding intergenerational downward mobility (Breen and Goldthorpe 1997). According to RRA, a previous negative outcome affects the final educational outcome because it lowers the perceived probability of success at the next educational level and thus makes the decision to pursue further education less likely. However, as Lucas (2009) shows in an RRA model, the perceived probability of success is not a relevant parameter in school continuation decisions of upper-class students. In fact, to avoid downward mobility, upper-class students will always choose to continue education and seek access to the most advantageous programs, regardless of their prior negative educational outcomes.

Besides arguing that upper-class families will usually overcome cost constraints, the RRA model does not offer an explanation of how low-performing students of upper-class families manage to gain access to and complete higher levels of education despite their previous mediocre performance. The theory of effectively maintained inequality (EMI) complements RRA on this point (Lucas 2009).

EMI posits that socioeconomically advantaged families effectively use their resources and act to maintain advantages for their children (Lucas 2001). In the case of an early negative outcome that might put their children's chances of educational attainment in jeopardy, upper-class families will mobilize academic and nonacademic resources to guarantee their advantage is maintained. These families could, for instance, spend more time helping their children in study activities or pay for private tutoring. They could also pressure teachers to not hold back their children or move their children to a different school. In this respect, it is crucial that socioeconomically advantaged families have more economic, social, and cultural resources that can be deployed to overcome an early negative outcome.

These arguments posited by RRA and EMI can be reversed to explain why socioeconomically disadvantaged families might not compensate, and could actually reinforce, an early failure. Disadvantaged families have fewer resources, and the negative consequences of an early disadvantage entail a smaller risk of downward social mobility for their children because their starting positions are already low. In case of a failure, these families might opt to divert resources to children in the family who are more successful at school.

Methodological Considerations

The task of identifying effects consistent with compensatory advantage is not straightforward. Failure at time t, F_t, or success, S_t, do not occur at random. Individuals who fail at time t are a selected group, and selection might operate differently depending on social background. To discuss the issue of endogeneity relating to compensatory effect more formally, one might first consider an additive linear probability model where the probability of a successful outcome at time t + 1 depends on a previous outcome at time t and on social background.

$$P(S_{t+1}) = \beta_o + \beta_1(F_t) + \beta_2(U) + \varepsilon, \quad (4)$$

where $P(S_{t+1})$ is the probability of success at time $t + 1$; F_t indicates failure at time t; U represents membership in the upper class; β_o, β_1, and β_2, are parameters to be estimated; and ε is a random disturbance term. If β_1 differs from 0, Equation 2 expresses a path model of sequential outcomes, so that the prior history of transitions affects the subsequent one. One can then ask whether a previous outcome at time t, F_t (or its reciprocal state S_t), has a causal effect on S_{t+1}. This implies scrutinizing the assumption that F_t is exogenous to ε. This assumption holds if $\text{cov}(F_t, \varepsilon) = 0$. In the case of educational trajectories, this assumption is likely wrong for two reasons.

First, anticipated decisions regarding S_{t+1} might already drive results at time t (Morgan 2012). In other words, subjects might self-select into F_t due to having no real interest in S_{t+1}. Second, unobserved characteristics might affect both S_{t+1} (or F_{t+1}) and S_t (or F_t). Individuals with low academic ability, for instance, are likely to fail at t and $t + 1$, but there is no added effect of failure at t itself. In the case of an anticipated decision, and with spurious association due to unobserved traits, endogeneity bias would imply that the size of the expected negative coefficient β_1 in Equation 4 would be overestimated.

Next, the compensatory advantage mechanism effect can be represented as an interactive model where the impact of a previous failure on a subsequent successful outcome is conditional on social background. Formally,

$$P(S_{t+1}) = \beta_0 + \beta_1(F_t) + \beta_2(U) + \beta_3 F_t \times U + \varepsilon, \quad (5)$$

where $P(S_{t+1})$ is the probability of success at time $t + 1$; F_t indicates failure at time *t*; U represents membership in the upper class; $F_t \times U$ is an interaction term between a previous failure and social background; β_0, β_1, β_2, and β_3 are parameters to be estimated; and ε is a random disturbance term.

The compensatory effect in Equation 5 is represented by the parameter β_3. Parameter β_1 is expected to be negative, and β_3 should be positive. This means negative consequences of a previous failure on subsequent success are smaller for upper-class individuals. The crucial problem, however, is that endogeneity biases highlighted for Equation 4 extend to the interactive model 5.

To get a consistent estimation of β_3, one must thus control for all individual characteristics and anticipated decisions that might affect educational outcomes at time t and $t + 1$. Data requirements are severe, and anticipated decisions are often difficult to uncover.

PREVIOUS STUDIES OF COMPENSATORY ADVANTAGE AND EDUCATIONAL INEQUALITY

Given the broad topic, I focus on studies of compensatory advantage that fall within three areas of educational inequality: influence of children's endowments at birth on cognitive development and later educational attainment (Almond and Mazumder 2013); effect of poor school performance on school continuation decisions, typically at the end of compulsory education (Bernardi and Cebolla-Boado Forthcoming); and consequences of nontraditional trajectories through college (Goldrick-Rab 2006). This review substantiates the concept of compensatory advantage with concrete examples in studies of educational inequality and highlights the different identification strategies employed by previous studies to estimate its parameter.

The key question driving the first group of studies is whether parents compensate or reinforce differences in their children's health and cognitive endowments at birth (Conley 2008). Recent studies indicate that initial differences in endowments at birth among siblings in lower-class families persist in the long run and translate into larger differences in later outcomes, whereas poorly endowed children from upper-class families tend to catch up with their better endowed siblings (Almond and Mazumder 2013). In this line of research, the most compelling evidence of compensatory advantage in education comes from a natural experiment used by Almond, Edlund, and Palme (2009), who show that in utero exposure to Chernobyl fallout in Sweden affected cognitive ability at birth. Students born in regions with higher levels of fallout, who thus had more radiation exposure, performed worse in secondary school. The penalty associated with exposure to radiation, however, was largely concentrated among children born to less educated parents.

Studies that directly investigate parental investment responses to initial differences in children's endowments also show heterogeneity by families' socioeconomic standing (Hsin 2012; Restrepo 2012). Parental investments in upper-class families tend to compensate for an early disadvantage, whereas disadvantages are reinforced in lower-class families. For instance, Hsin (2012), who used Panel Study of Income Dynamics (PSID) data, finds that highly educated mothers devote more total time and educationally oriented time to children with lower birth weight. Less educated mothers, on the other hand, invest more time to higher birth weight children. Similarly, using the 1979 cohort of the National Survey of Longitudinal Youth, Restrepo (2012) shows that highly educated mothers compensate for an initial low birth weight by investing more in the noncognitive development of their low birth weight children relative to their normal weight children. Conversely, less educated mothers reinforce the initial disadvantage of low birth weight children by providing them with less emotional support relative to their normal birth weight siblings.

The second set of studies of educational transitions consistently shows that previous level of academic performance predicts entry into the next level of education (Breen and Jonsson 2005). Some studies also show that low performers from socioeconomically advantaged families are disproportionally likely to move on to higher education, compared to similarly low-performing students from disadvantaged backgrounds. For instance, in the French case, among students of higher socioeconomic standing with below average grades finishing compulsory education, almost two out of three (nearly 60 percent) enter the most prestigious academic track, which enables them to later enter universities. The same is true for only one in seven (15 percent) students with below average grades whose parents are manual workers (Bernardi and Cebolla-Boado Forthcoming). This social background compensatory advantage in transition to higher education despite low prior performance has been observed in very different social contexts, such as Soviet Leningrad in the late 1960s (Yanowitch 1977) and the United States in the late 1970s (Carneiro and Heckman 2003).

Finally, other studies have investigated path dependency in educational trajectories (Dauber, Alexander, and Entwisle 1996; Kerckhoff 1993). Research focusing on university education shows that trajectories through college are strongly dependent on students' choices in the early phase of their college careers (Pfeffer and Goldrick-Rab 2011). Milesi (2010) finds that following nontraditional trajectories, like interrupting enrollment temporarily or being enrolled part-time, reduces the chances of earning a bachelor's degree in the United States. However, the degree of path dependency varies by social background: Students from advantaged backgrounds are more sheltered from the negative consequences of initial negative outcomes, like failing to meet the credit threshold in the first year of college (Pfeffer and Goldrick-Rab 2011). Similarly, Breen and Jonsson (2000), who analyze mobility between educational paths in Sweden, find the largest social background inequalities among individuals who took more indirect and unusual paths, such as the route to tertiary education for those who left school after compulsory education and completed upper-secondary education abroad or in the adult educational system.

In these studies, which explicitly address the problem of causal identification of parameters of the cumulative and compensatory advantage models, we find four common identification strategies. First, some studies include a long list of controls, such as educational aspirations and measures of cognitive abilities, to reduce the scope of biases due to anticipated decisions and unobserved characteristics that are correlated with both failure at time t and success at time t + 1 (Pfeffer and Goldrick-Rab 2011). Second, other studies tackle the endogeneity bias by using a simultaneous estimation approach, either within a latent variable framework or with a Heckman two-stage selection model (Bernardi 2012; Breen and Jonsson 2000). Third, some studies turn to sibling fixed-effect models to partial out time-invariant, family-specific unobserved factors that might correlate with both failure at time t and success at time t + 1 (Hsin 2012; Restrepo 2012). Finally, other studies exploit sources of exogenous assignment on the state of failure F at time t, via natural experiments or a regression discontinuity design (Almond et al. 2009). I pursue the latter option because on balance, it seems to offer more advantages than the other strategies.[2]

MONTH OF BIRTH AND REGRESSION DISCONTINUITY DESIGN

Access to the first year of school is regulated in most countries by a cutoff date (December 31 in many European countries), so for the year k, children born before the cutoff date will enter school in year k, and those born after the cutoff will enter school one year later. If this rule is strictly enforced, children born just before the cutoff are 11 months younger when they start school than their classmates born just after the cutoff. At the extreme, being born one day before or after the cutoff date can account for a one-year age difference in starting school. Due to this administrative rule, some children have to start school when they are, on average, less emotionally, physically, and intellectually developed than others. Recent comparative estimates for OECD countries show that the youngest members of a school entry cohort score 2 to 9 percent lower on standardized tests, compared to the oldest members, in eighth grade (Bedard and Dhuey 2006). In France and Spain, the youngest students are also more likely to repeat one grade during compulsory education.

The core idea of this article is to estimate a model of compensatory advantage using a regression discontinuity design based on the cutoff date for access to primary education and respondent's birth month. In this design, birth month is interpreted as a factor at time t that is negatively associated with the probability of success S in school at time t + x. The advantage of this design is that birth month should be randomly distributed around the cutoff date with respect to socioeconomic background. If this assumption holds, using birth month as an indicator of F_t overcomes the endogeneity problem associated with consistent estimation of parameters of the compensatory advantage model.

Since Angrist and Krueger's (1991) seminal article, three main critiques have been raised against use of season and month of birth as instruments for educational attainment in wage equations. Although these critiques refer to use of birth month in an instrumental variable (IV) framework, it is worthwhile to explore their implications for a regression discontinuity design. First, research shows that season of birth is a weak instrument for educational outcome, and use of an instrument that explains little of the variation of the endogenous variable might result in inconsistent and biased estimates (Bound, Jaeger, and Baker 1995). A weak instrument in an RD setting implies there is no discontinuity around the cutoff date in the probability of success at a later school transition. If this were true, the RD design would not make sense in the first place.

Second, as an instrument, birth season might violate the monotonicity assumption (Barua and Lang 2009). This assumption requires that although the instrument may have no effect on some individuals, for all who are affected, the effect goes in the same direction. In countries where parents can decide to enroll early or postpone school entry, children born just before the cutoff will be the youngest in their school cohort, if their parents follow the administrative rule, or the oldest, if their parents postpone school entry by one year. The opposite is true in the case of early enrollment: Children born just after the cutoff will be the oldest, if the rule is followed, or the youngest, if they enroll early.

Third, evidence shows that birth season is not fully random but varies depending on mothers' socioeconomic characteristics (Buckles and Hungerman 2013; Torche and Corvalan 2010). Birth season fails the exclusion restriction on family background and thus is not a valid instrument. A possible association between parents' socioeconomic characteristics and birth month would also have significant consequences for the RD design of this article because the crucial idea of an exogenous assignment to F_t would be questioned. In this respect, even if there is an association between birth season and parents' socioeconomic background, one is unlikely to find a similar association comparing two consecutive months.[3] The assumption of a zero association between parents' socioeconomic background and birth month can, however, be tested, and I will do so as a starting point for the empirical analysis. With regard to the two other critiques to use of birth month in an RD design, I will argue that their scope is very limited given the specificities of the French educational system, which I describe in the next section.

THE INSTITUTIONAL SETTING: WHY FRANCE?

The administrative rule for enrollment in primary education in France is that children start primary education the calendar year during which they turn 6 years old. Children born in December are therefore the youngest in their school cohort, and those born in January are the oldest. Primary education (*escole ellementaire*) is divided into three learning cycles and lasts five years, from ages 6 to 11. Pupils then move to lower secondary (*college*), which lasts five more years. At the end of lower secondary education and the *process* *d'orientation*, students are assigned to academic or vocational tracks.

Three characteristics of the French educational system make it particularly appropriate to consider grade repetition as a dependent variable and to use an RD design based on the cutoff date of admission to primary education as a strategy for estimating the compensatory advantage model. First, postponement of admission into primary education (sometimes called redshirting) is not permitted by educational authorities, with the exception of pupils with special educational needs due to physical, sensorial, or mental disabilities (Euridyce 2011). In contrast to the United States and many other EU countries, there is no possibility of redshirting in France; the proportion of pupils attending pre-primary education among children who are of primary school age is extremely low, only 1.4 percent (Euridyce 2011). This characteristic is crucial for the good functioning of the regression discontinuity. As mentioned before, studies that use birth month as an instrumental variable or a forcing variable in a regression discontinuity design in countries where a large proportion of children do not start school at the prescribed age have been criticized for violating the monotonicity assumption, and they produce inconsistent estimates of the local average treatment effect of interest (Barua and Lang 2009). This concern is not an issue for RD designs in countries where the entry age rule is strictly enforced, such as France.

The second reason why France is an interesting case is that the proportion of children who have to repeat a grade is high. Grade retention is determined by class teachers when a child fails to reach performance levels expected for promotion to the next grade. The proportion of repeaters in primary education in France is about 20 percent and is among the highest in OECD countries (Euridyce 2011).

Third, recent evidence based on identification strategies that deal with the endogeneity of retention and later educational and occupational attainment shows that grade repetition leads to long-term negative consequences (Goosa et al. 2013; Manacorda 2012). In the French case, Alet, Bonnal, and Favard (2012) use simultaneous equations to explore the determinants and consequences of early retention. They find that early grade retention, in first and second grade, had a positive modest effect on test scores at third grade, but the effect became negative by sixth grade. Using various instruments, Brodaty, Gary-Bobo, and Prieto (2008) document that one year of delay in one's school-leaving age (mainly due to grade retention) causes a sizeable (about 9 percent) decrease of wages at entry into the labor market. Grade repetition and promotion are thus important educational outcomes for social stratification.

DATA AND VARIABLES

The empirical analysis uses data from The Panel d'Élèves du Second Degré (1995 to 2001) of the French Ministry of education (DEPP 2008). This is a French longitudinal study of students who entered lower secondary school in September 1995. In my analyses, I consider students who have valid information on parents' education, were born in France, and had no special educational needs.[4] The final analytic sample contains 14,323 students.[5] In the regression discontinuity, I further restrict the sample to children born in the months before and after the cutoff date for admission to school (December 31). In the preferred specification, I limit the analysis to children born between November and February (*n* = 6,091).

The choice of a two-month bandwidth before and after the cutoff date is based on the optimal bandwidth selection procedure proposed by Imbens and Kalyanaraman (2011). I tested the sensitivity of the choice of bandwidth as recommended by Imbens and Lemieux (2008). I also report results using twice the preferred bandwidth (i.e., four months)—thus comparing children born in September, November, and December to those born in January, February, April (*n* = 9,304)—and estimates using half the preferred bandwidth (i.e., one month), thus comparing children born in December to those born in January (*n* = 3,094).[6]

Equation 6 presents the compensatory advantage model I estimated in my analyses.

$$\begin{aligned} \mathrm{P(promotion)} &= \beta_0 + \beta_1(\mathrm{Young}) \\ &+ \beta_2(\mathrm{U}) + \beta_3 \mathrm{Young} \times \mathrm{U} + \varepsilon, \end{aligned} \tag{6}$$

where P(promotion) is the probability of having been promoted every year throughout primary education; it corresponds to S_{t+1} in the compensatory advantage model of Equation 5. *Young* refers to students who were younger than their peers at the onset of primary school. It corresponds to F_t in the compensatory advantage model of Equation 5. The variable *U* refers to parents' education; β_0, β_1, β_2, and β_3 are parameters to be estimated; and ε is a random disturbance term. Equation 6 is

Table 1. Description and descriptive statistics for the variables in the analysis.

Variable name and values	Description	Percentage
Promotion in primary education	1 if successfully promoted after every grade throughout primary education	78.1
Female	1 if female	48.6
Parental education	Highest level of father's and mother's education	
Lower secondary or less		27.5
Vocational (CAP/BEP)		33.3
Upper secondary (BAC)		15.8
University		23.5
Total		100.0
Young	1 if born in November and December, 0 if born in January and February	49.6

Source: Panel d'élèves du second degré 1995 (Panel of students starting lower secondary education in 1995) collected by the French Ministry of Education; own calculations.
Note: Sample restricted to n = 6,091 students born in France, without special educational needs in French elementary school and with valid information on parental education, who were born between November and February.

estimated only for students born just before and after the cutoff for admission to primary education.

The probability of having been promoted every year throughout primary education is defined using students' year of birth. Given the strict compliance with the law on age for starting school in France, children who started lower secondary education in 1995 and have not been held back a grade should have been born in 1984. Children born before 1984 are accordingly defined as repeaters. Based on this definition, the proportion of repeaters in elementary school is 21.9 percent.[7]

Young is a dummy variable equal to one for children born in the last months of the year. In the preferred specification, it is equal to one for children born in November and December and zero for those born in January and February. For the variable U (for the socioeconomically advantaged upper class), I use the highest level of father's and mother's education for each respondent. The variable has four categories: lower secondary education or less (*elementaire, primaire*, and no education), upper vocational education (CAP and BEP), upper academic education, and university education. In sensitivity analyses, I also use parents' occupation coded in a sixfold version of Erikson and Golthorpe's (1992) class scheme that distinguishes upper class (includes professionals, managers, and higher level technicians), self-employed workers with large or small firms, routine nonmanual employees of higher grade (clerical occupations), routine nonmanual employees of lower grade, workers (skilled and unskilled manual workers), and farmers. All analyses control for gender. Descriptive statistics for the sample restricted to students born between November and February (n = 6,091) are reported in Table 1.

Equation 6 is estimated with a linear probability model (Angrist and Pischke 2008). Coefficients of the linear probability model are almost identical to the average marginal effects of the logit model. The advantage of the linear probability model over the logit model is that the interpretation of marginal effect of the interaction at the core of our analysis is much more straightforward (Norton, Wang, and Ai 2004).

I also replicated the analyses using different definitions of the dependent variable and using parents' occupational class instead of parents' education.[8] The findings presented in the following are robust to these different specifications.

RESULTS

Before discussing the core results of the compensatory advantage model, I present two preliminary findings that confirm the soundness of the regression discontinuity design. Figure 1 shows the proportions of students who were promoted throughout primary education as proximity to the cutoff date of December 31 increases. Chances of successful promotion after every grade in primary

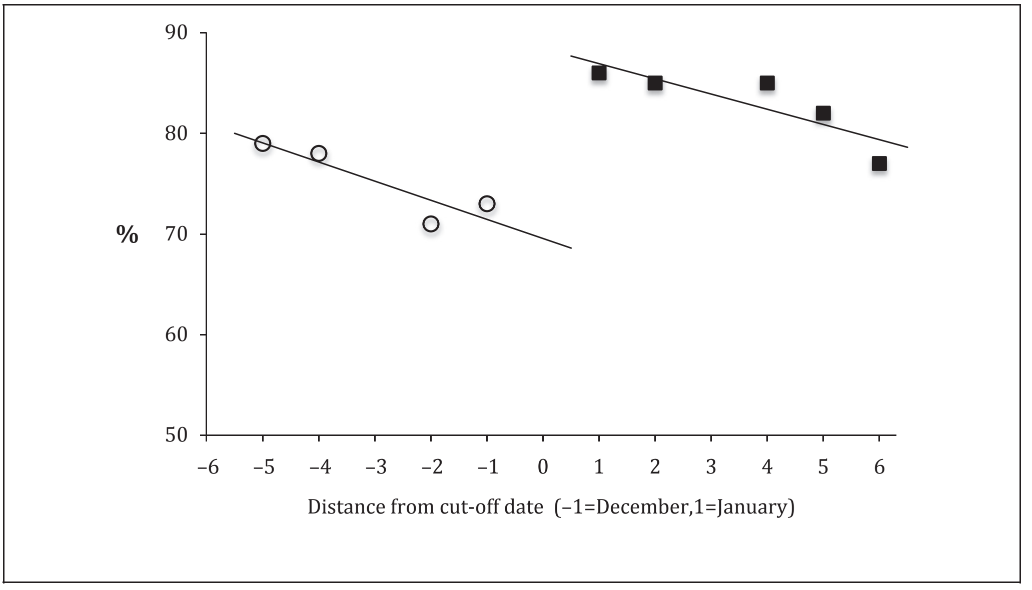

Figure 1. Percentages of students who are successfully promoted after every grade in primary education in France, by distance of their month of birth from the cutoff date for admission (December 31).
Source: Panel d'élèves du second degré 1995 (Panel of students starting lower secondary education in 1995) collected by the French Ministry of Education; own calculations.
Note: Sample restricted to *n* = 14,323 students born in France, without special educational needs in French elementary school and with valid information on parental education.

education are 13 percentage points higher for children born in January (86 percent), the oldest of their school cohort, compared to children born in December (73 percent), the youngest of their cohort. The figure shows no other visible jumps in the chances of promotion, which declines smoothly moving from the first months of the year toward the cutoff at the end of December. Figure 1 documents a clear discontinuity at the cutoff date for admission to the first year of primary education.

Next, I examine whether the probability of being born just before or after the cutoff varies with parents' education. If that were the case, the crucial assumption for the RD design of random assignment on the two sides of the cutoff date would not hold. To test this possibility, I cross-tabulate birth month and parents' education and compute a chi-square test of independence for the two months before and after the cutoff (Table 2). The chi-square is equal to 8.1 with 9 degrees of freedom and thus statistically nonsignificant.[9] Based on this result, I cannot reject the null hypothesis of independence between parents' education and birth month around the cutoff date.

Table 3 presents results of the regression discontinuity to test highly educated families' compensatory advantage in reducing the negative consequences of an early age at school start for the probability of promotion in primary education. Model 1 confirms the bivariate findings of Figure 1. The estimate for the dummy variable *young* expresses the effect of being born in November or December, compared to January or February, and shows that being born in the months just before the cutoff reduces the chances of promotion by 14 percentage points, compared to being born just after the cutoff. This effect is sizeable, being about three times as large as the much investigated gender difference.

Model 2 is a specification of the compensatory advantage model. It includes the critical interactions between parents' education and the dummy variable *young*. The positive sign of this interaction indicates that children from highly educated families are more sheltered from the penalty associated with a young age at school start. For children from less educated families, chances of promotion are 19 percentage points lower for students born at the end of the year compared to

Table 2. Month of birth by parental level of education (France, column percentages).

Month of birth	Lower secondary or less	Upper vocational	Upper secondary	University
	Parental level of education			
January	25.3	25.7	25.5	25.0
February	26.7	23.9	25.0	24.1
November	24.5	25.1	22.9	24.0
December	23.5	25.3	26.6	25.9
Total	100.0	100.0	100.0	100.0
N	1,602	2,029	980	1,480

Source: Panel d'élèves du second degré 1995 (Panel of students starting lower secondary education in 1995) collected by the French Ministry of Education; own calculations.
Note: Sample restricted to $n = 6{,}091$ students born in France, without special educational needs in French elementary school and with valid information on parental education, who were born between November and February.

Table 3. Regression discontinuity of the probability of successful promotion after every grade in primary education in France (estimates of linear probability models with robust standard errors in parentheses).[a]

Bandwidth	November to February Model 1	November to February Model 2	December to January Model 3	September to April Model 4
Female	0.05** (0.01)	0.05** (0.01)	0.06** (0.01)	0.05** (0.01)
Parental education				
Lower secondary or less (reference category)				
Upper vocational	0.15** (0.02)	0.12** (0.02)	0.14** (0.03)	0.16** (0.02)
Upper secondary	0.25** (0.02)	0.22** (0.02)	0.22** (0.03)	0.24** (0.02)
University	0.31** (0.02)	0.25** (0.02)	0.25** (0.03)	0.28** (0.01)
Young[b]	–0.14** (0.01)	–0.19** (0.02)	–0.17** (0.03)	–0.15** (0.02)
Parental education × Young				
Upper vocational × Young		0.05 (0.03)	0.02 (0.05)	0.02 (0.02)
Upper secondary × Young		0.06 (0.03)	0.02 (0.05)	0.04 (0.03)
University × Young		0.12** (0.03)	0.10* (0.02)	0.08** (0.02)
Constant	0.67** (0.01)	0.70** (0.02)	0.68** (0.02)	0.68** (0.02)
N	6,091	6,091	3,094	9,304

Source: Panel d'élèves du second degré 1995 (Panel of students starting lower secondary education in 1995) collected by the French Ministry of Education; own calculations.
[a]Sample restricted to students born in France, without special educational needs in French elementary school and with valid information on parental education, who were born between November and February (model 1 and 2), December and January (model 3), and September and April (model 4).
[b]*Young* refers to those born in January and February compared to those born in November and December (Model 1 and 2), in January compared to those born in December (Model 3) and in January, February, and April compared to those born in September, November, and December (Model 4).
$*p < .05$. $**p < .01$.

their peers born in January or February. For students from highly educated families, the birth month penalty is much smaller, 7 percentage points. Figure 2 displays this compensatory advantage; it shows the predicted probabilities of promotion after each grade in primary education, based on estimates of Model 2 for a male student.

Differences among the bars for parents' education in Figure 2 are larger for students born in November or December. This means inequality

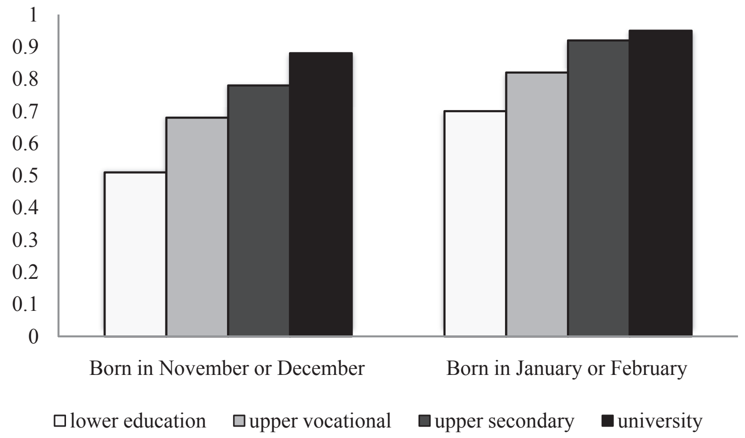

Figure 2. Predicted probabilities of successful promotion after every grade in primary education in France by months of birth and parental education.
Source: Panel d'élèves du second degré 1995 (Panel of students starting lower secondary education in 1995) collected by the French Ministry of Education; own calculations.
Note: Sample restricted to *n* = 6,091 students born in France, without special educational needs in French elementary school and with valid information on parental education, who were born between November and February; the predicted probabilities are based on the estimates of model 2 in Table 3.

by social background is larger among students who were younger at school entry (i.e., children born in November or December), compared to students who were older when school started (i.e., children born in January or February). Moreover, for children whose parents have a university education (see the two black bars in Figure 2), there is almost no difference between being younger or older at the start of school. The difference is sizeable, however, between the two white bars that refer to students with less educated parents.

As recommended by Imbens and Kalyanaraman (2011), I also report estimates using twice the preferred bandwidth and half the preferred bandwidth. Estimates in Model 3 are based on a bandwidth of four months, and the variable *young* distinguishes children born in September to December from those born in January to April. Estimates in Model 4 are based on a bandwidth of one month, and the variable *young* distinguishes children born in December from those born in January. As expected, the point estimates slightly decrease with the larger bandwidth, and the confidence intervals become larger with the narrower bandwidth, but both specifications confirm that the birth month penalty is, to a large extent, concentrated among children from less educated families.

CONCLUSIONS AND DISCUSSION

Compensatory advantage is a general mechanism of stratification, due to which individuals from advantaged social backgrounds are buffered against the negative consequences of a prior adverse outcome. It complements ideas of cumulative disadvantage and path dependency, commonly employed in studies of social stratification. Cumulative disadvantage explains a pattern of growing inequality over time, when the current level of a given resource has causal effects on accumulation of future resources. Compensatory advantage explains patterns of growing inequality in which the cumulative disadvantage process is weaker for upper-class individuals. Studying compensatory advantage enriches our understanding of the development of inequality over the life course, in so far as its underling mechanisms differ from those of cumulative disadvantage. In the case of cumulative disadvantage, the generative mechanism is found in the causal relationship between F_t and F_{t+1}. For compensatory advantage, the generative mechanism involves heterogeneous parental responses by social origins to F_t.

I argued that the theoretical bases of compensatory advantage in educational trajectories lay in both RRA and EMI theories. The RRA provides the motivational base of the compensatory advantage, namely, that the upper class has a stronger interest in correcting a child's negative educational outcome to avoid the risk of downward social mobility. In the case of school continuation decisions, RRA implies that subjective beliefs of future educational success are irrelevant for upper-class students; these students will continue in school to maintain their social standing despite previous mediocre school results. In other words, RRA predicts a compensatory effect in educational trajectory. RRA is silent, however, on how the compensation comes about, that is, how poorly performing upper-class students manage to continue in school and achieve the highest level of education. EMI complements RRA on this specific point by predicting that upper-class families will deploy all available resources, including nonacademic and nonmeritocratic resources, to minimize the negative consequences of an initial negative outcome and secure educational advantage for their children. In summary, the notion of compensatory advantage holds great promise for the exploration of further complementarity between RRA and EMI (Lucas 2009).

This article also discussed difficulties related to the consistent estimation of the parameters of a compensatory advantage model. Prior negative outcomes or adverse events do not usually happen at random. This is clearly the case for educational trajectories, where a prior educational outcome at time t is very likely endogenous to a subsequent outcome at t + 1. I thus provided an example of an identification strategy that allows estimation of consistent parameters of the compensatory advantage model. I used an RD design based on the cutoff date for admission to primary school in France to study how birth month affects promotion through primary education. In accordance with the notion of compensatory advantage, results of the RD show that being the youngest in one's school cohort entails less negative consequences for children of highly educated parents. These children had only a 7 percentage point reduction in the probability of continuous promotion through primary education, compared to a 19 percentage point reduction for children whose parents had less education.

The external validity of this finding is probably limited to countries with strict rules for school age entry that limit parents' decisions on early enrollment and redshirting, as well as countries with high levels of retention in primary education. Among European countries, Spain, Portugal, Luxembourg, and possibly the Netherlands satisfy these conditions (Euridyce 2011). It seems straightforward, however, to apply the notion of compensatory advantage to all instances in which a negative outcome at t reduces prospects of success at t + 1. For instance, research shows that events such as parental separation or juvenile arrest and problematic behaviors in adolescence such as early sexual intercourse or cannabis use have disruptive consequences for educational attainment (Frisco 2008; Hirschfield 2009; Lynskey and Hall 2000). Compensatory advantage might help in understanding whether social background not only helps in preventing the occurrence of these events and behaviors, but also in moderating their negative consequences.

The compensatory advantage mechanism might also operate in other dimensions of the life course, such as occupational careers and health. A proper research design should be identified for each situation to tackle the endogeneity intrinsic to the compensatory advantage model. The recent movement toward causal analysis in sociology provides us with the conceptual and technical tools to do so.

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NOTES

1. In Equations 1 and 2, compensatory advantage is operationalized in terms of differences in probabilities, but it can also be expressed in terms of ratios of probabilities:

$$P(S_{t+1}|S_t)L/P(S_{t+1}|F_t)L > P(S_{t+1}|S_t)U/P(S_{t+1}|F_t)U.$$

2. Each of the four identification strategies for compensatory advantage has its limitations. The "control for" strategy is difficult to pursue because information on anticipated decisions is hard to collect. Statistical solutions rely on strong assumptions and in some cases might actually increase the bias they are supposed to correct (Freedman and Sekhon 2010). For a cautionary note on the interpretation of sibling fixed-effect models, see Sigle-Rushton and colleagues (2014). The external validity of regression discontinuity research design can also be limited. The ideal solution would be to use these strategies in combination, but that is not feasible in a single article.
3. The same results that document an association between mother's education and birth season suggest such associations disappear comparing consecutive months (within a season). The difference between December and January in the fractions of children born to mothers with basic and superior education is .0025 (Buckles and Humgerman 2013:Table 1).
4. Students born abroad make up 3.8 percent of the original sample. I excluded them because they might have joined primary education in France after the official date of school start for their cohort. Their case deserves a special analysis that was not possible to perform within the limits of the current article. Students with special educational needs are identified by their prior attendance of *classe d'intégration scolaire*. They account for 1.2 percent of the original sample. I excluded these students because the strict rule about age at enrollment in primary education does not apply to them.
5. Information on parents' education was collected in a special follow-up survey in 1998. It is available for 86 percent of students in the original sample. In the analysis, I use a special weight provided by the data producer to correct for nonresponse in 1998.
6. Students born in March, July, and October were not recruited into the panel.
7. I also constructed the dependent variable using information on the year respondents started elementary education and the answer to a question in the 1998 follow-up survey that asked families whether the student had been held back a grade during elementary school. A cross-classification of the variables based on the three different definitions shows a very high level of consistency among them. I use the variable based on respondents' birth year because it minimizes the number of missing cases.
8. Results of the sensitivity checks are available in the online Appendix Tables 1 and 2 (at http://soe.sagepub.com/).
9. I also replicated this test for the narrower bandwidth (December vs. January) and the larger one (September to December vs. January to April). The chi-square statistics are 1.2 with 3 degrees of freedom and 13.0 with 15 degrees of freedom, respectively. Both tests are statistically nonsignificant, and thus the null hypothesis of independence between birth month and parents' education cannot be rejected.

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