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# School tracking and access to higher education among disadvantaged groups<sup>☆</sup>

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## ABSTRACT

When students are tracked into vocational and academic secondary schools, access to higher education is usually restricted to those who complete an academic track. Postponing such tracking may increase university attendance among disadvantaged students if additional time in school enables them to catch up with their more privileged counterparts. However, if ability and expectations are fairly well set by an early age, postponing tracking during adolescence may not have much effect. This paper exploits an educational reform in Romania to examine the impact of postponing tracking on the proportion of disadvantaged students graduating from university using a regression discontinuity (RD) design. We show that, although students from poor, rural areas and with less educated parents were significantly more likely to finish an academic track and become eligible to apply for university after the reform, this did not translate into an increase in university completion. Our findings indicate that simply postponing tracking, without increasing the slots available in university, is not sufficient to improve access to higher education for disadvantaged groups.

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## 1. Introduction

The relationship between family background and access to higher education is a robust empirical finding across many countries.<sup>1</sup> Yet there is debate about whether this relationship is mostly predetermined at an early age or can be mediated through investments in schooling. [Carniero and Heckman \(2002\)](#), [Heckman \(2004\)](#) argue that long-run factors shape ability and expectations early on and therefore emphasize the importance of early childhood investments. On the other hand, [Krueger \(2004\)](#) contends that the return to human capital investments remains high even beyond adolescence, and especially for those from less advantaged family backgrounds. But how important is age? Can the relationship between family background and access to higher education be influenced by the timing of educational transitions in secondary

school? This paper exploits a unique educational reform in Romania which postponed when students were tracked into academic and vocational schools in order to examine whether such later tracking improves access to higher education among socio-economically disadvantaged children.<sup>2</sup>

The Romanian educational reform, which occurred in 1973, prevented students from entering vocational schools after only 8 years of schooling and, instead, required them to receive an additional 2 years of academic curricula. Due to this policy change, students born after January 1, 1959 were more likely to complete an academic high school curriculum as compared to their counterparts who were born immediately before this date. By increasing the fraction of students who completed academic high school, the reform also increased the proportion of students who became eligible to apply to university, while the number of mandated university slots remained unchanged. Using data from the Romanian Census, we employ a regression discontinuity (RD) design to show that students from poor and rural regions and from less educated families, who

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<sup>1</sup> [Shavit and Blossfeld \(1993\)](#) provide evidence from thirteen countries at various levels of development.

<sup>2</sup> In earlier work, we focused on whether the increased exposure to general education in academic schools affected labor market outcomes later in life ([Malamud and Pop-Eleches, 2010](#)). We provided evidence that the educational reform did not lead to an increase in average years of schooling or an increase in the proportion of students completing university. In this paper, we focus on access to higher education among socio-economically disadvantaged students.

were less likely to complete university, were also those most affected by the policy. However, although these disadvantaged students did become significantly more likely to be eligible for university after the reform, this did not translate into a relative increase in university attendance and graduation.<sup>3</sup> If more time in academic schools had enabled disadvantaged students to catch up with their privileged counterparts, delaying the timing of tracking should have increased university completion among the disadvantaged. Instead, our findings indicate that simply postponing tracking, without increasing the number of slots available in university, is not sufficient to improve access to higher education for disadvantaged students.

Many countries track pupils into academic and vocational schools at some point during their secondary education. Some countries, such as Austria, Germany, and Hungary track students as early as age 10, while others, such as the United States, have traditionally had relatively little tracking across schools even at older ages. One of the main arguments for tracking is that it is easier to teach a homogenous group of students.<sup>4</sup> On the other hand, the possibility of positive spillover effects from more able to less able students is a common argument against tracking. Early tracking may also be inefficient when ability is measured with noise because some students end up assigned to the wrong track (Brunello et al., 2006). For Germany, Dustmann (2004) shows that parental background is strongly related to the secondary track choice of the child, and to subsequent educational achievements. Based on this evidence, Dustmann suggests that early tracking may explain the low levels of intergenerational mobility in Germany. Nevertheless, in the absence of any exogenous variation in the timing of tracking, it is difficult to provide truly compelling evidence. Manning and Pischke (2006) evaluate several studies in England and Wales which estimate the effect of moving from a system of extensive tracking to one with comprehensive schools on academic achievement but conclude that selection bias is a serious threat to validity and urge caution when interpreting results.<sup>5</sup> In a cross-country setting, Hanushek and Wößmann (2006) find evidence that tracking raises educational inequality but Waldinger (2007) argues that these results are not particularly robust to alternative specifications. Taking advantage of the unique educational reform in Romania, we use a regression discontinuity design to address the possibility of omitted variable bias and selection bias. Importantly, although Romania's labor market under Communism was structured rather differently from those in other countries, the education system was actually quite similar to many systems with explicit constraints on the number of university slots and competitive entry into high school and university.

We also contribute to a growing literature which examines the impact of educational reforms in postwar Europe, and Scandinavia in particular. Meghir and Palme (2005) examine a Swedish reform which increased compulsory schooling, abolished selection, and introduced a nationally unified curriculum. Exploiting a period of experimentation across municipalities during the 1950s, they find that the reform increased educational attainment and earnings for students from low SES families. Aakvik et al. (2010) examine a similar reform in Norway which extended compulsory schooling, introduced comprehensive schools and established a common curriculum in the 1960s. Although they focus on estimating returns to schooling, they also find that the reform increased the probability of attending university and weakened the effect of family background on the likelihood of participating in higher education. Pekkarinen et al. (2009) show that an analogous reform

in Finland significantly decreased the intergenerational income elasticity. Nevertheless, it is difficult to isolate the effect of tracking in the earlier work because most of the educational reforms affected both the amount of education and the timing of selection. In the case of Romania, average years of schooling attained by students remained the same before and after the 1973 educational reform.<sup>6</sup>

The paper is organized as follows. Section 2 provides a background of the Romanian educational system and the 1973 educational reform. Section 3 describes these data and the empirical strategy. Section 4 presents the results, and Section 5 concludes.

## 2. Background

### 2.1. Education in Romania

Apart from the changes induced by the 1973 reform, the structure of education in Romania throughout the 1970s was relatively stable. Students began compulsory schooling by entering schools of general education (*scoală de cultură generală*) at the age of 6. More specifically, students entered grade 1 in September of the year following the calendar year in which they reached 6 years of age. Since the mid-1950s, these schools offered 8 years of general education, nominally composed of primary education from grades 1 to 4 and gymnasium education from grades 5 to 8.<sup>7</sup> Prior to the educational reforms of 1973, students who graduated from schools of general education entered vocational schools and apprenticeship programs or continued onto academic secondary school lyceums, where entry was based on competitive exams.

The main types of academic secondary schools included the theoretical lyceums (*licee teoretice si real-umaniste*) which were the most selective, as well as industrial lyceums (*licee industriale*), teacher training lyceums (*licee pedagogice*), economic lyceums (*licee economice*), agricultural lyceums (*licee agricole*). All lyceums operated at two distinct levels. The first level corresponded to grades 9 and 10 of compulsory general education, while the second level offered general education in grades 11 and 12. Curriculum in the first level was essentially homogenous across lyceums:

“During the first 2-years of lyceum education, students are offered a basically uniform curriculum both in academic and practical subjects whatever the character or orientation of a lyceum, its stated aims are to offer a well-balanced integrated curriculum composed of a number of subjects in the humanities, social studies, and the sciences, as well as subjects related to practical training in a particular field.” (Braham, 1978, p. 10).

Graduates from the first level of lyceum who did not take further courses in the second level received a certificate of graduation from 10-year compulsory education (*certificat de absolvire a învățământului obligatoriu de 10 ani*). Admission to the second level was based on a composite score computed from academic achievement in the lower level and a competitive entrance exam. Graduates from the second level who passed the baccalaureate exam received the baccalaureate diploma (*diploma de bacalaureat*) while those who failed received a certificate of graduation (*certificat de absolvire*). The vast majority of students enrolled in the second level of lyceum did pass the baccalaureate exam.

Vocational schools (*școli profesionale*) provided training in numerous trades ranging from aircraft maintenance to winemaking. They also operated at two levels: a lower vocational track for students who

<sup>3</sup> University drop-out rates during this period in Romania were so low that attendance and completion were essentially identical (Braham, 1978).

<sup>4</sup> Duflo et al. (forthcoming) argue that this explains the positive benefits associated with a (within-school) tracking intervention Kenya.

<sup>5</sup> Maurin and McNally (2007) examine a more recent educational reform in 1989 that widened access to the academic track in Northern Ireland.

<sup>6</sup> The increase in years of schooling among those who became eligible for university by completing high school was offset by a reduction in years of schooling by students who left before completing high school (and no longer acquired additional vocational education).

<sup>7</sup> Some general schools also included grades 9 and 10 (*ciclul superior de 2 ani*), usually as branches of secondary school lyceums.

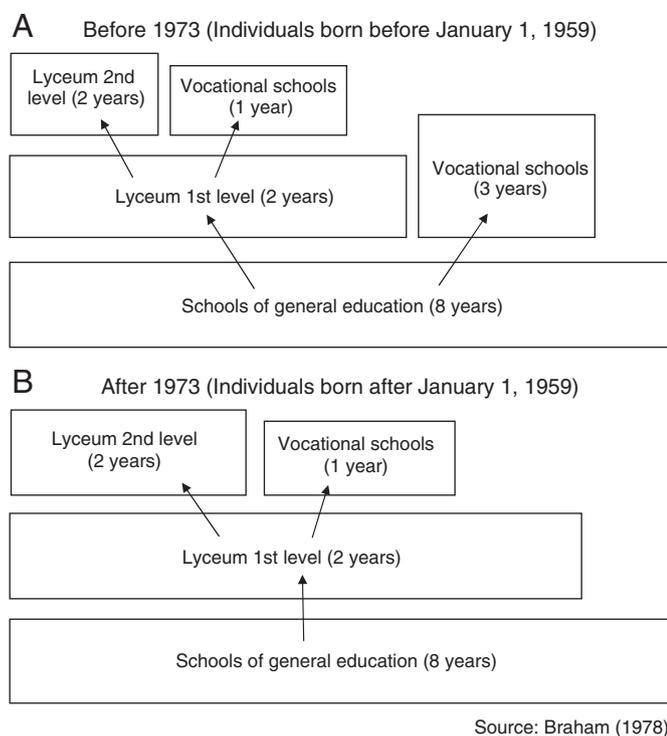


Fig. 1. Structure of education in Romania.

had completed 8 years of general education and an upper vocational track for students who had received an additional 2 years of general education in the first level of lyceum. The length of training varied by trade and depending on whether students completed an additional 2 years of general education: “In 1967–68 vocational schools offered training in 232 trades, 175 of which required 3 years and 57, 2 years” (Braham, 1972, p. 73).

Entrance to higher education in universities, institutes, academies and conservatories was open to graduates of the second level of lyceum schools and required a baccalaureate diploma.<sup>8</sup> Universities were under the central control and supervision of the Ministry of Education, which also determined the number of openings at the different universities in accordance with current and projected needs. During the 1960s, the number of university slots expanded rapidly so that enrollment in 1968–69 was more than double that in 1960–1961 (Braham, 1972). However, the number of slots remained roughly constant throughout the 1970s. At that time, Romania had 42 institutions of higher education which offered degrees varying from a minimum of 3 years for teacher training to a maximum of 6 years for medicine. Admission to university was open to all graduates of secondary education holding a baccalaureate diploma and entry was based on competitive oral and written exams administered in July of each year. Successful applicants were selected solely based on the scores achieved on these exams, subject to the predetermined quotas at each university (Braham, 1972). In contrast to the baccalaureate exam, university entrance exams were much harder to pass and it was not uncommon for a student to re-apply for a number of years before being admitted. Once accepted, students very rarely dropped out of university so attendance and graduation rates were very similar.

<sup>8</sup> In addition, technical schools for master craftsmen admitted graduates of vocational schools who had spent between 3 and 5 years in production. A small number of postsecondary specialization schools admitted graduates of lyceums and trained them in specialized fields, but these were abolished in 1977.

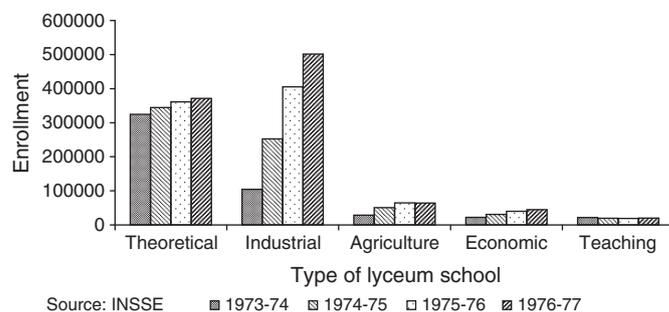


Fig. 2. Change in lyceum enrollment by main specialty from 1973–74 to 1976–77.

Thus, in most respects, the educational system in Romania was quite comparable to those which existed (and continue to exist) in many other countries. Schools followed a national curriculum and entry into high schools and universities was constrained with admission based on competitive exams. Although the Communist labor market of the 1970s was associated with a highly compressed wage structure, attending a prestigious lyceum or university was considered an extremely desirable outcome. Even under Communism, higher education bestowed social status and allowed entry into the more highly valued professional jobs. As a result, we believe that the findings of this study may be applicable to other settings where the number of university slots is constrained.

## 2.2. The educational reform of 1973

The educational reforms of 1973, consisting of Decree No. 278 and the Resolution of the Communist Party's Central Committee of June 18 and 19, 1973, were intended to increase the proportion of students with 10 years of general schooling. In particular, the Resolution of June 1973 stated that “beginning with the school year 1974–75, the entire graduating class of grade 8 will start in grade 9 of lyceums; vocational schools will no longer accept students from this class [grade 8] directly.”<sup>9</sup> Thus, these reforms prevented students from entering vocational schools after 8 years of general education and required them to enter the first level of lyceum schools instead. The structures of the educational system before and after the change in 1973 are depicted in Fig. 1. Depending on their aptitudes, skills, and preferences, graduates of the first level of lyceum schools could (i) enter the workforce, (ii) continue to vocational school for 1 year, or (iii) continue to grades 11 and 12 in the second level of lyceum schools. The emphasis on additional general education after 1973 caused a marked decrease in the prevalence of vocational training. As one secondary source explains, the number of students in vocational schools “decreased during the 1970s because of the extension of compulsory education to include 2 years in the lyceum.” (Braham, 1978, p. 11).

The Resolution of June 1973 also introduced measures to assure that sufficient qualified teachers and school resources (such as science laboratories, classrooms, and dormitories) were allocated to local authorities. In most cases, these measures did not require any physical movement of resources; teachers and schools remained the same but their training and the curriculum were changed. Specifically, the 1973 Resolution stated that:

“In order to provide for an effective educational environment and to use the existing facilities efficiently,...lyceums will, in general, function within the same premises as vocational schools and under the same leadership.”

<sup>9</sup> These excerpts from the Resolution of the Communist Party's Central Committee of June 18 and 19, 1973 are translated by the authors from the original Romanian text.

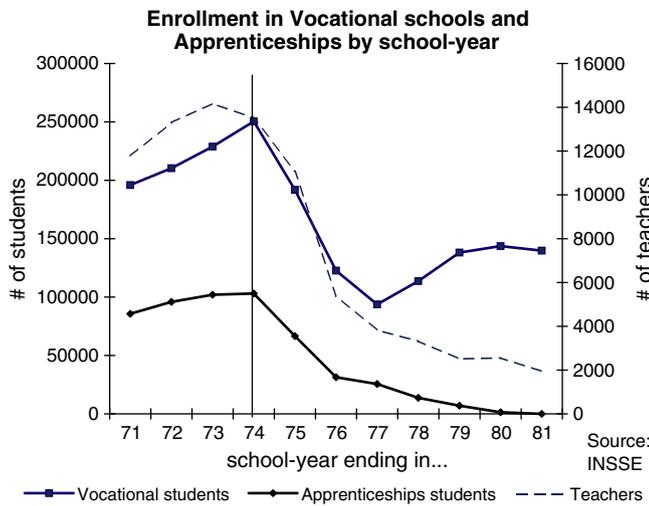


Fig. 3. Enrollment in vocational schools and apprenticeships by school-year.

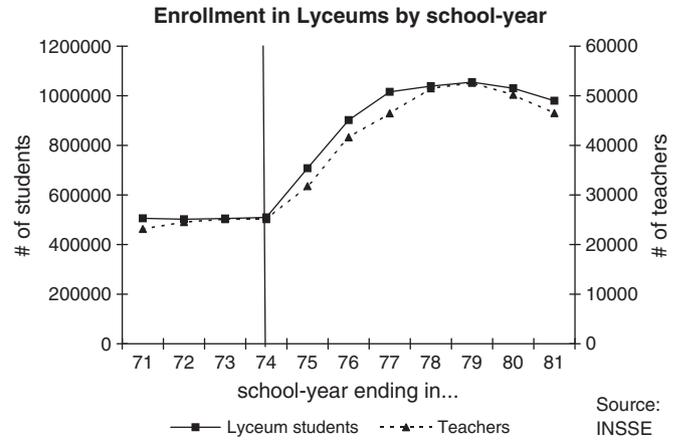


Fig. 4. Enrollment in lyceums by school-year.

Since most students who were prevented from entering vocational schools after grade 8 in the fall of 1974 were placed in the first level of lyceum within existing vocational schools, they remained with mostly similar peer groups in grades 9 and 10. With some expansion of the second level of lyceums after the reform, the marginal student who entered this track may have been exposed to slightly better peers, on average, during the final 2 years of secondary school. However, as seen in Fig. 2, the largest increase in lyceum enrollment was in the somewhat less selective industrial high schools. Thus, while the marginal student who graduated from a lyceum rather than a vocational school due to the policy change was probably exposed to better peers, the increase in peer quality was likely limited because of the already high level of sorting in different types of lyceums before and after the 1973 reform.<sup>10</sup>

We can document some of these changes using aggregate data from the *Annual Statistics of the Socialist Republic of Romania* (Romanian Government, 1960–1980). Fig. 3 shows the large decline in the number of students enrolled in vocational schools and on-the-job apprenticeships between the school years 1973–74 and 1975–76. During this period, enrollment in lyceums increased sharply, as shown in Fig. 4. At the same time, the number of teachers in vocational schools fell and the number of teachers in lyceums rose in the initial years following the educational reform.

Further evidence for these dramatic changes comes from the Romanian Census of 1992. Since students began their compulsory schooling at age 6, they would have completed grade 8 by age 14 and grade 10 by age 16. As a result, students born in 1958 would have been unaffected by the policy while those students born in 1959 would have been required to continue to grades 9 and 10 of lyceum schools. Fig. 5 shows the highest educational attainment by year of birth for individuals from the Romanian Census of 1992. There is a sharp decline in the proportion of individuals with vocational training between cohorts born in 1958 and 1959. At the same time, we observe a sharp increase in the proportion of individuals who complete the first level (grades 9–10) and second level (grades 11–12) of a general lyceum education. No such discontinuity is observed for the proportion completing only lower/primary or those completing university. This is consistent with the historical evidence that the

supply of slots at Romanian universities did not change for the cohorts affected by the 1973 educational reform.

### 3. Empirical strategy

#### 3.1. Data

The primary dataset for the empirical analysis combines two independent random samples from the 1992 Romanian Census.<sup>11</sup> For each respondent, the census collected basic socioeconomic characteristics (such as gender, region of birth, rural/urban indicator of birth) and detailed information about the highest level of educational attainment. Education levels are classified as follows: primary education, gymnasium education, first stage of lyceum education (grade 9 and 10), second stage of lyceum education (grades 11 and 12), vocational training and apprenticeships, post-secondary education, and university education.<sup>12</sup> Two features make this dataset especially useful for our analysis: First, with approximately 90,000 observations in each yearly birth cohort, we have sufficient power to employ a regression discontinuity design. Second, there is detailed information about the month and year of birth so we can identify the discontinuity induced by the policy within a relatively narrow window.

A number of the individual and parental background indicators serve as important markers of social class. Among these, whether an individual was born in a rural or urban setting is a particularly relevant indicator in Romania, whose economy prior to World War II was primarily oriented towards agriculture, and where rural status continued to be an important social issue in Romania during the transition period (Florian and Serbanescu, 1998). We also define a dummy variable indicating whether an individual was born in one of the 20 (out of 41) poorest regions of the country, as measured by regional GDP in the 1990s. In addition, we interact the two preceding variables to construct an indicator of being born in a rural locality of a poor region. Finally, we consider indicators for whether each of the parents has only a primary or no education. When examining parental characteristics, we have to restrict our attention to those individuals who are still in the same household as their parents. Although this sample is not completely representative of the overall population, we

<sup>10</sup> The effect of changing peer groups on average educational attainment and other outcomes would be essentially zero in the presence of linear peer effects. However, since we are interested in access to higher education among disadvantaged groups, a change in peer groups could explain our findings.

<sup>11</sup> These include a 15% sample from the Population Activities Unit (PAU) of the United Nations Economic Commission for Europe (UNECE) and a 10% sample from IPUMS International. We have verified that these two samples are two separate random draws from the universe of all responses.

<sup>12</sup> Note that, since these categories are mutually exclusive, we cannot determine whether students with vocational training and apprenticeships also completed the first stage of lyceum education.

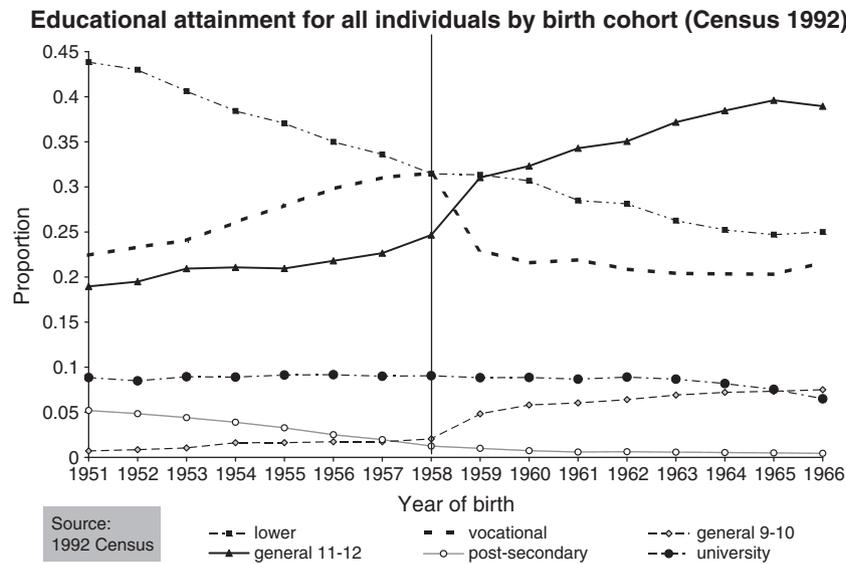


Fig. 5. Educational attainment for all individuals by birth cohort (Census 1992).

have tested that the probability of living with a parent is not affected by the educational reform.<sup>13</sup>

Table 1 presents summary statistics for the full sample used in the study (i.e. all individuals in cohorts born between 1956 and 1961): approximately 27% complete vocational training, 4% complete 9th and 10th grade in the first level of lyceum, and 27% complete 11th and 12th grade in the second level of lyceum. Over 9% graduate from university while only 1% of students complete some other form of post-secondary training. Summing the last three categories, we determine that almost 38% of students were eligible by law to apply for entrance into university (including, of course, those who actually completed university). Roughly 72% of the sample is rural born, indicating that Romania was a predominantly rural country even through the late 1950s. Finally, parental educational is very low, with 50% of fathers and 64% of mothers having received only a primary education or no education at all. Note that all these background characteristics, including gender, are very similar between the pre-reform and post-reform cohorts (not shown here).

3.2. A regression discontinuity design

We take advantage of the 1973 educational reform in order to estimate the effect of postponing tracking. Since this reform went into effect during the 1974–75 school year and students enter grade 1 in September after the calendar year in which they reached 6 years of age, those individuals born before January 1, 1959 were unaffected by the policy while those born after this date had their tracking postponed. With detailed information on date of birth, we can estimate the impact of this policy using a regression discontinuity design.

We first examine the effect of the 1973 educational reform on educational attainment. Our primary educational outcomes include (a) eligibility to apply to university and (b) university graduation. We consider the following regression equation:

$$educational\_outcome_i = \beta'X_i + AFTER_i + f(c_i) + \varepsilon_i \quad (1)$$

where  $X_i$  includes fixed effects for calendar month of birth to control for seasonal differences between individuals born in different months.

<sup>13</sup> Regression discontinuity estimates for the probability of residing with either the mother or father using our main specifications are all statistically insignificant.

Table 1  
Descriptive statistics.

	Entire sample		
	Mean	SD	N
<i>Educational attainment</i>			
Vocational	0.27	0.45	448,636
General 9–10	0.04	0.19	448,636
General 11–12	0.27	0.44	448,636
Post secondary	0.01	0.12	448,636
Eligible for University	0.38	0.48	448,636
University Graduate	0.09	0.28	448,636
<i>Background characteristics</i>			
Rural born	0.72	0.45	449,991
Born poor region	0.51	0.50	450,156
Born rural and poor region	0.40	0.49	449,991
Mother primary education	0.64	0.48	86,928
Father primary education	0.50	0.50	65,447
Male	0.50	0.50	450,156

Notes: SD is the standard deviation and N is the sample size. All summary statistics based on all individuals born between 1956 and 1961 (within 3 years of January 1, 1959). Source: 1992 Romanian Census.

$AFTER_i$  is equal to 1 if individual  $i$  was born on or after January 1, 1959 and 0 if born on or before December 31, 1958. Finally,  $f(c_i)$  is a function of date of birth, which is the forcing variable in this context. As in many recent studies employing this technique and as suggested by Imbens and Lemieux (2008), we specify a flexible parametric model by including higher order polynomials of date of birth.<sup>14</sup> We consider specifications that use linear, quadratic and cubic trends in month of birth, as well as linear, quadratic, and cubic splines (i.e. trends where the month of birth is fully interacted with  $AFTER$ ).<sup>15</sup> All binary outcome variables are estimated using a linear probability model but we have also verified that non-linear regression methods, such as logit and probit, yield similar results.

<sup>14</sup> See Dinardo and Lee (2004) for use of parametric functions in regression discontinuity design. Lee and McCrary (2005) and Card et al. (2008) specifically use parametric functions of date of birth.

<sup>15</sup> Estimating this equation using non-parametric methods, along the lines of Hahn et al. (2001) also leads to similar results.

Next, we examine how the 1973 educational reform changed the composition of students from certain social classes who were (a) eligible to apply to university, or who (b) graduated from university. To answer this question, we consider the following regression model:

$$social\_class_i = \lambda' X_i + AFTER_i + f(c_i) + v_i \tag{2}$$

where all of the right-hand side variables are defined as in Eq. (1), and *social\_class<sub>i</sub>* is one of our five markers of social class based on personal and parental background characteristics: (i) rural/urban place of birth, (ii) born in poor region, (iii) born in poor region in rural locality, (iv) mother has only primary education or less and (v) father has only primary education or less. We run this regression for the sample of students who are eligible for university and for the sample who complete university. Consequently, in this specification, the coefficient on *AFTER<sub>i</sub>* indicates the effect of the reform on the proportion of disadvantaged students eligible for university or graduating from university. We also report an alternative set of specifications where we estimate Eq. (1) for eligibility to university and graduating from university while restricting the sample to different disadvantaged groups.

Our regression-discontinuity (RD) approach essentially compares the outcomes of individuals in cohorts affected by the 1973 educational reform to their counterparts in cohorts born too early to be affected. We use a three year window on either side of the cutoff, including all individuals born between January of 1956 and December 1961. The choice of the window is somewhat arbitrary as we need to strike a balance between the advantages of having more precise estimates with larger windows and mitigating the possibility of confounding time effects with more narrow windows. Therefore, we also present robustness checks where use broader and narrower windows. All regressions cluster on month of birth in order to avoid the problems associated with specification error in the case of discrete covariates (Lee and Card, 2007).

#### 4. Results

##### 4.1. Effect of the reform on educational attainment

The 1973 reform had a dramatic effect on the level and type of educational attainment, shown in Fig. 5. As mentioned previously, the reform forced students to enter vocational school after 10 years of schooling and therefore required them to receive an additional 2 years of general education. The reform also increased the number of slots in academic high schools for the remaining 2 years (in grades 11 and 12). Table 2 provides precise estimates for the impact of the reform on several different educational outcomes, corresponding to Eq. (1) from the preceding section. The rows show the coefficient on *AFTER* using alternative polynomial trends. Column (1) indicates that children born after January 1959 were between 7 and 10 percentage points less likely to receive a vocational education. Given that the base probability of receiving a vocational education during this period was about 0.27, this represents an extremely large effect. Columns (2) and (3) reveal that students who were shifted out of vocational schools ended up completing their education in academic schools instead. The larger increase was among students who completed grades 11–12, and thereby became eligible to apply for university. On the other hand, columns (4) and (5) indicate that the 1973 reform had only a small effect on post-secondary educational attainment and virtually no effect on university graduation.<sup>16</sup> Eligibility for university includes students who completed all 4 years of academic lyceums, as well as those

<sup>16</sup> Fig. 1 makes it clear that the importance of post-secondary education is relatively small and diminished even further after the reform. Moreover, the coefficient on *AFTER* in column (4) is only significant in certain specifications.

**Table 2**  
Reduced-form estimates for the effect of the 1973 educational reform on educational outcomes.

Coefficient on AFTER	Vocational (1)	General 9–10 (2)	General 11–12 (3)	Post secondary (4)	Eligible for university (5)	University graduate (6)
Linear	0.093*** [0.005]	0.026*** [0.002]	0.050*** [0.003]	0.001 [0.001]	0.051*** [0.003]	−0.001 [0.001]
Quadratic	−0.092*** [0.003]	0.026*** [0.002]	0.049*** [0.003]	0.001* [0.001]	0.050*** [0.003]	−0.001 [0.001]
Cubic	−0.080*** [0.004]	0.020*** [0.002]	0.046*** [0.004]	0.002** [0.001]	0.045*** [0.004]	−0.003* [0.002]
Linear spline	−0.092*** [0.003]	0.026*** [0.002]	0.050*** [0.003]	0.001** [0.001]	0.050*** [0.003]	−0.001 [0.001]
Quadratic spline	−0.076*** [0.004]	0.018*** [0.002]	0.044*** [0.004]	0.002*** [0.001]	0.043*** [0.005]	−0.004* [0.002]
Cubic spline	−0.067*** [0.006]	0.016*** [0.002]	0.047*** [0.007]	0.003** [0.001]	0.049*** [0.007]	−0.002 [0.003]
Cal. month dummies	Y	Y	Y	Y	Y	Y
Sample size	448,636	448,636	448,636	448,636	448,636	448,636
Mean of dep. variable	0.27	0.04	0.27	0.01	0.38	0.09

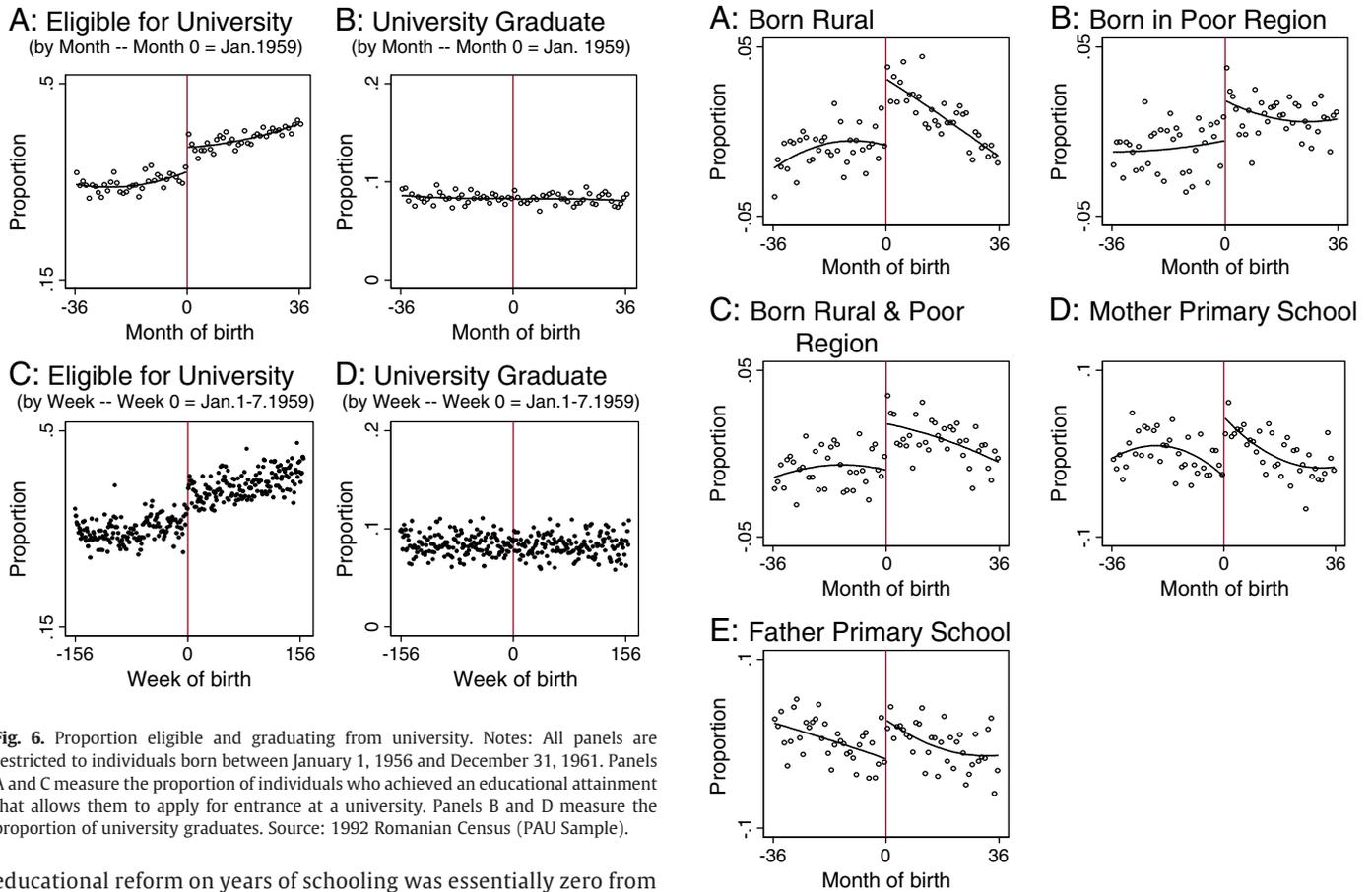
Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961. The dependent variables are defined in Table 1. Each cell corresponds to a separate regression and presents the coefficient on *AFTER* in Eq. (1). *AFTER* is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958. All regressions include 11 calendar month dummies.

who actually went on to complete a post-secondary or university education. Column (6) shows that the 1973 reform increased eligibility for university by approximately 5 percentage points, or over 13%, regardless of which polynomial trend is used to control for the forcing variable.

These results are consistent with our understanding of the educational system in Romania and the specific reform in 1973: The policy change switched a large fraction of students from vocational to academic schools. As a result, many more students were able to take the baccalaureate exam at the end of high school and become eligible to take the entrance exam at one of the nation's universities. However, this did not translate into an increase in overall university graduation because the number of university slots was constrained by the government and remained unchanged during our period of study. Fig. 6 plots the proportion of individuals eligible for university and the proportion of individuals graduating from university by month and week of birth. As expected, Panels A and C show an extremely sharp discontinuity after January, 1959 (normalized as month 0) for those eligible for university. Individuals born merely two weeks apart had very different likelihoods of being eligible for university. No such discontinuity can be observed for the fraction of students completing university in Panels B and D.

Note that the 1973 reform did not lead to increases in overall educational attainment. While there was an increase in the number of students who continued to grades 11 and 12 in academic lyceums and thereby became eligible for university, there was also an increase in the number of students who completed only 10 years of schooling. Using data from Romanian LSMS household surveys in 1995 and 1996 to estimate the impact of the 1973 reform on years of schooling, we found insignificant effects ranging from about 0.02 to 0.09 years of schooling.<sup>17</sup> Thus, the net effect of the 1973

<sup>17</sup> These results are similar to those for men in Malamud and Pop-Eleches (2010).



**Fig. 6.** Proportion eligible and graduating from university. Notes: All panels are restricted to individuals born between January 1, 1956 and December 31, 1961. Panels A and C measure the proportion of individuals who achieved an educational attainment that allows them to apply for entrance at a university. Panels B and D measure the proportion of university graduates. Source: 1992 Romanian Census (PAU Sample).

educational reform on years of schooling was essentially zero from both a statistical and substantive perspective.

4.2. Effect of the reform on access to higher education

Having established that the 1973 educational reform increased the overall fraction of students eligible to apply to university, we consider

**Table 3**  
Reduced-form estimates for the effect of the 1973 educational reform on eligibility to attend university by different groups.

Coefficient on AFTER	Rural born	Born poor region	Born rural and poor region	Mother primary education	Father primary education
	(1)	(2)	(3)	(4)	(5)
Linear	0.038*** [0.007]	0.022*** [0.007]	0.028*** [0.006]	0.049*** [0.010]	0.042*** [0.009]
Quadratic	0.037*** [0.005]	0.022*** [0.007]	0.027*** [0.006]	0.046*** [0.009]	0.042*** [0.009]
Cubic	0.041*** [0.006]	0.024** [0.009]	0.028*** [0.007]	0.071*** [0.010]	0.050*** [0.013]
Linear spline	0.035*** [0.005]	0.021*** [0.007]	0.027*** [0.006]	0.046*** [0.009]	0.042*** [0.010]
Quadratic spline	0.041*** [0.007]	0.023** [0.010]	0.029*** [0.008]	0.076*** [0.012]	0.051*** [0.015]
Cubic spline	0.039*** [0.012]	0.023* [0.013]	0.033*** [0.010]	0.048** [0.020]	0.049** [0.022]
Cal. month dummies	Y	Y	Y	Y	Y
Sample size	169,339	169,450	169,339	31,638	24,557
Mean of dep. variable	0.58	0.45	0.32	0.42	0.27

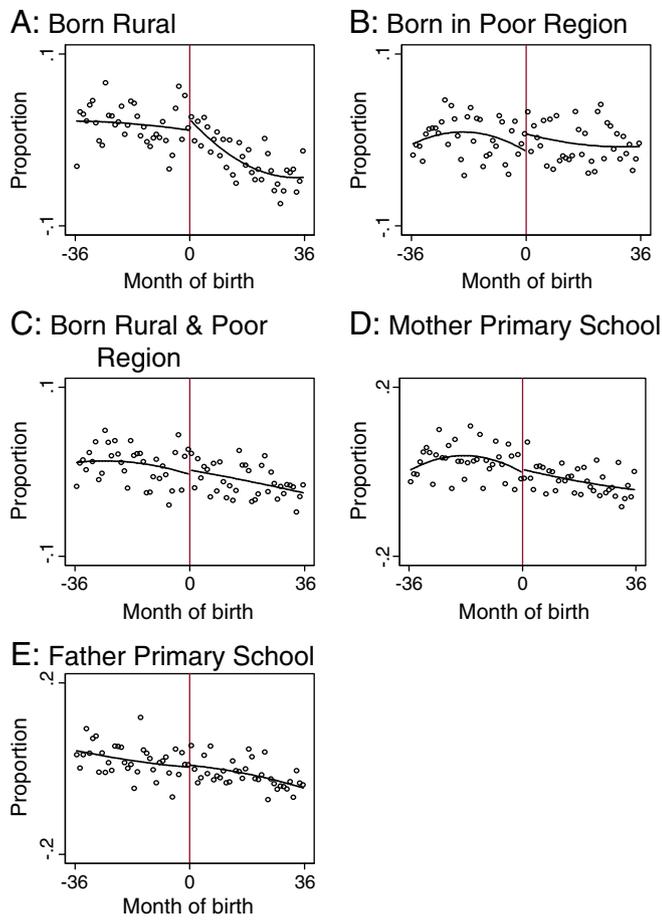
Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961 who achieved an educational attainment that allows them to apply for entrance at a university. The dependent variables are defined in Table 1. Each cell corresponds to a separate regression and presents the coefficient on AFTER in Eq. (2). AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958. All regressions include 11 calendar month dummies.

**Fig. 7.** Eligibility to apply to university (by month of birth). Notes: All panels are restricted to individuals who achieved an educational attainment that allows them to apply for entrance at a university and who are born between January 1, 1956 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a quadratic polynomial in month of birth. The open circles are residuals from regressions of the dependent variable on 11 calendar month dummies. Background variables are defined in Table 1. Source: 1992 Romanian Census.

the impact of the reform on the socio-economic composition of students eligible to apply for university. Table 3 presents regression results for the sample of students eligible to apply for university, corresponding to Eq. (2) from the previous section. Column (1) indicates that the 1973 educational reform increased the proportion of eligible students who were born in a rural region by approximately 4 percentage points, using any number of different polynomial trends. Similarly, column (2) shows that the proportion of eligible students who were born in a poor region increased by over 2 percentage points. Combining these two dependent variables, column (3) reveals that the proportion of eligible students who were born in poor and rural regions increased by almost 3 percentage points, or 10% of the mean.

The effect of the policy on social composition in terms of parental education is even more striking.<sup>18</sup> Columns (4) and (5) display the effect on the proportion of eligible students whose mother or father had a minimal level of educational attainment. In either case, the

<sup>18</sup> As mentioned earlier, the sample of individuals still living with their parents is not necessarily representative of the overall population. However, the probability of living with one's parents does not reveal a discontinuity around the birth cohort cutoff suggesting this is not a concern for our design.



**Fig. 8.** Actual graduation from university (by month of birth). Notes: All panels are restricted to individuals who graduated from university and who are born between January 1, 1956 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a quadratic polynomial in month of birth. The open circles are residuals from regressions of the dependent variable on 11 calendar month dummies. Background variables are defined in Table 1. Source: 1992 Romanian Census.

estimated impact of the educational reform on the proportion of individuals with less educated parents is large and highly significant. Fig. 7 also reveals a sharp discontinuous jump in the proportion of eligible students who come from poor and disadvantaged backgrounds according to all five markers of social class.<sup>19</sup> We interpret these results as evidence that the marginal person affected by the reform came from a lower social class than the average person who was eligible to apply for university. In other words, the reform increased the likelihood that children from less advantaged backgrounds would complete an academic high school and have the opportunity to apply for university.

We proceed to examine whether the increase in eligibility for university among disadvantaged students led to an increase in the probability of graduating from university. Fig. 8 displays the proportion of university graduates who were born in rural regions, poor regions, rural and poor regions, as well as those whose mother or father have especially low levels of educational attainment.

<sup>19</sup> The open circles plot residuals from regressions of the dependent variables on fixed effects for calendar month of birth, to eliminate seasonal differences. The solid lines are fitted values to residuals from regressions of the dependent variable on a quadratic polynomial in month of birth.

This graph is analogous to Fig. 7 but with the sample restricted to students who graduated from university. In contrast to the patterns for eligibility, we do not observe any discontinuities in the composition of social class for university graduation. These findings are confirmed in Table 4 which shows that the estimated coefficients on  $AFTER_i$  are essentially zero for almost all of our alternative specifications. The effects are somewhat less precisely estimated in the case of parental education due to sample size and with the inclusion of some higher order polynomial trends. Nevertheless, the pattern is consistent across all markers of social class. The 1973 educational reform made students from disadvantaged backgrounds relatively more likely to be eligible for university but this did not translate into a increase in the proportion of disadvantaged students completing university.<sup>20</sup>

We also considered alternative specifications in which we estimated the effects of the 1973 reform on eligibility for university and graduation from university separately for each of the five disadvantaged groups. Appendix Table 1 indicates that the effect of the reform on the probability of becoming eligible for university is generally larger for those who are more disadvantaged. In contrast, Appendix Table 2 reveals that the educational reform did not increase the probability of actually attending university for either disadvantaged or non-disadvantaged students. These estimates largely confirm the findings from the main specifications in the paper.

Finally, we attempted to calculate the implied effect of the 1973 reform on university attendance for disadvantaged students based on the rates of university attendance from earlier cohorts. Using newly available data from the 1977 Romanian Census, we estimated the probability of attending university for students who had completed different types of lyceums just prior to the 1973 educational reform (i.e. cohorts born 1954 to 1958).<sup>21</sup> Then we multiplied these probabilities by the increase in enrollment of disadvantaged students in each type of lyceum. The overall “implied” effect of the 1973 reform on university attendance were approximately 0.008 for individuals from rural and from poor regions and 0.007 for individuals with less-educated parents. In most cases, we can reject these “implied” effects from the estimated coefficients of university attendance in Appendix Table 2. Thus, if disadvantaged students who became eligible for university due to the 1973 reform would have been able to take full advantage of this opportunity, we would have expected to see much larger effects on university attendance.

#### 4.3. Robustness checks

We have performed a number of additional tests to check the robustness of our results. Appendix Table 4 examines the sensitivity of the effects on eligibility for university. Panel A presents three alternative windows around the discontinuity: a one year window including students born between 1958 and 1959, a two year window including students born between 1957 and 1960, and a four year window including students born between 1955 and 1962. As in Table 3, the effect of the 1973 educational reform on the proportion of eligible students from disadvantaged backgrounds is highly significant in each of these specifications. Panel B presents estimates for alternative year cutoffs; i.e. “placebo experiments” around January 1

<sup>20</sup> In addition, we examined whether the 1973 reform had a differential effect on males and females. Appendix Table 3 shows that the reform increased the proportion of males who became eligible for university but did not change in the proportion of males actually going to university.

<sup>21</sup> Rates of university attendance were 25% in theoretical lyceums, 19% in industrial lyceums, and substantially lower in most other types of lyceums.

<sup>22</sup> Note that we use a one year window for all the placebo experiments to minimize the contamination of our estimates with the actual reform that came into effect for those born in 1959.

**Table 4**

Reduced-form estimates for the effect of the 1973 educational reform on actual attendance of university by different groups.

Coefficient on AFTER	Rural born (1)	Born poor region (2)	Born rural and poor region (3)	Mother primary education (4)	Father primary education (5)
Linear	0.002 [0.012]	0.005 [0.011]	0.003 [0.010]	−0.016 [0.016]	0.018 [0.015]
Quadratic	0.004 [0.011]	0.005 [0.011]	0.003 [0.010]	−0.017 [0.016]	0.017 [0.015]
Cubic	0.016 [0.016]	0.018 [0.013]	0.008 [0.014]	0.003 [0.022]	0.011 [0.021]
Linear spline	0.003 [0.010]	0.005 [0.011]	0.003 [0.010]	−0.018 [0.016]	0.017 [0.015]
Quadratic spline	0.016 [0.017]	0.022 [0.015]	0.008 [0.016]	0.013 [0.026]	0.01 [0.023]
Cubic spline	−0.024 [0.022]	0.013 [0.020]	−0.02 [0.020]	0.001 [0.042]	0.015 [0.032]
Cal. month dummies	Y	Y	Y	Y	Y
Sample size	40,065	40,135	40,065	8326	6631
Mean of dep. variable	0.40	0.38	0.21	0.20	0.11

Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961 who graduated from university. The dependent variables are defined in Table 1. Each cell corresponds to a separate regression and presents the coefficient on AFTER in Eq. (2). AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958. All regressions include 11 calendar month dummies.

of the two preceding years and two following years. We find essentially no significant differences in the proportion of eligible students from disadvantaged backgrounds using these alternative year cutoffs around January 1 of 1957, 1958, 1960 and 1961.<sup>22</sup> Appendix Table 5 examines the sensitivity of the effects on university graduation. Panel A indicates that there are no significant differences in the proportion of university graduates from disadvantaged backgrounds using either broader or narrower windows around the discontinuity. Panel B shows that there is no significant difference in the proportion of university graduates from disadvantaged backgrounds using alternative year cutoffs. We have also confirmed that the analogous “placebo” experiments for the effect of the 1973 reform on educational attainment in Table 2 are generally insignificant (results not shown).

#### 4.4. Quality of education

The competitive nature of entry into secondary education in Romania resulted in substantial sorting of students by socioeconomic background. Hence, even before the educational reform, it is likely that students from disadvantaged backgrounds were enrolled in schools with less able peers. These schools may have also drawn teachers from lower parts of the ability distribution. Though the reform would have increased the average quality of peers for the marginal student affected, the evidence suggests that most of the affected students attended the less prestigious industrial high schools. Therefore, the postponement of tracking probably did not drastically increase the quality of peers or schools for these disadvantaged students but, rather, opened up the opportunity to complete an academic track in high school and apply to university.

The drastic expansion of general education in Romania so essential to credibly identifying the effect of vocational training may have also caused a short-run reduction in the quality of academic education. Moreover, with an educational reform that affected such a large fraction of the school-age population, the question of how resources were allocated to implement the reform becomes extremely important. As mentioned previously, the 1973 educational reform involved the reorganization of existing vocational schools which were transformed into “combo schools” offering both vocational and general high school education. Figs. 2 and 3 show the influx of teachers from vocational to general high school and indicate that the average student/faculty ratios across the two types of schools were largely maintained.

Although we have some anecdotal evidence that retraining occurred, these teachers may nevertheless have been relatively inexperienced at teaching the new curriculum. Nevertheless, in a related paper, we provide evidence that changes in the quality of academic schools were unlikely to explain the absence of effects on labor market outcomes in later years (Malamud and Pop-Eleches, 2010).

## 5. Conclusion

Whether the relationship between family background and access to higher education can be influenced by the timing of educational transitions in secondary school is an important question for human capital policy. This paper examines an educational reform in Romania which postponed the timing of tracking into academic and vocational schools. As a result, the proportion of students who became eligible to apply to university increased sharply, even while the number of university slots remained unchanged. Using data from the Romanian Census, we show that students from poor, rural areas and from less educated families who were less likely to complete university, were those most affected by the policy. These disadvantaged students were significantly more likely to become eligible to apply for university after the reform, suggesting that certain disadvantaged students were able to catch up to some degree with their more privileged counterparts in school. However, we find no corresponding increase in their relative likelihood of university attendance and graduation, indicating that the postponement of tracking did not help disadvantaged students catch with their more privileged counterparts in getting access to higher education.

How do we interpret these findings? Although Romania’s labor market under communism was structured rather differently from those in most countries today, the education system was actually quite similar to most systems with a national curriculum and competitive entry into high school and university. Moreover, the presence of explicit constraints on the number of university slots is common in many countries where the central government funds higher education directly.<sup>23</sup> Consequently, our findings may apply to other countries and other contexts where the number of university slots is relatively scarce. If more time in academic schools had enabled disadvantaged students to catch up with their privileged counterparts, postponing the timing of selection should have increased university completion among the disadvantaged. Instead, our findings suggest that simply postponing tracking, without increasing the number of slots available in university, was not sufficient to improve access to higher education. It is plausible that providing disadvantaged students with the opportunity to apply to university could have had an effect on university completion. That we do not find any effect is striking evidence to the contrary.

<sup>22</sup> Note that we use a one year window for all the placebo experiments to minimize the contamination of our estimates with the actual reform that came into effect for those born in 1959.

<sup>23</sup> Indeed, there is also evidence of supply-side constraints in the United States where there is relatively less public funding of higher education (Bound and Turner, 2007).

Appendix A

Appendix Table 1

Reduced-form estimates for the effect of the 1973 educational reform on eligibility to attend university by different groups.

Coefficient on eligibility to attend university	Rural born		Born poor region		Born rural and poor Region		Mother primary education	Mother primary education	Father primary education	Father primary education
	No (1)	Yes (2)	No (3)	Yes (4)	No (5)	Yes (6)	No (7)	Yes (8)	No (9)	Yes (10)
Linear	0.045*** [0.006]	0.056*** [0.003]	0.047*** [0.004]	0.055*** [0.005]	0.047*** [0.004]	0.058*** [0.005]	0.024** [0.012]	0.050*** [0.006]	0.046*** [0.010]	0.051*** [0.008]
Quadratic	0.044*** [0.006]	0.056*** [0.003]	0.046*** [0.004]	0.055*** [0.005]	0.047*** [0.004]	0.058*** [0.005]	0.024** [0.012]	0.050*** [0.006]	0.046*** [0.010]	0.051*** [0.008]
Cubic	0.029*** [0.007]	0.054*** [0.004]	0.042*** [0.006]	0.049*** [0.006]	0.040*** [0.005]	0.054*** [0.007]	0.011 [0.014]	0.062*** [0.008]	0.047*** [0.013]	0.051*** [0.010]
Linear spline	0.045*** [0.006]	0.056*** [0.003]	0.047*** [0.004]	0.055*** [0.004]	0.047*** [0.005]	0.058*** [0.005]	0.024** [0.012]	0.049*** [0.006]	0.045*** [0.010]	0.051*** [0.007]
Quadratic spline	0.022*** [0.008]	0.054*** [0.005]	0.041*** [0.006]	0.047*** [0.007]	0.038*** [0.005]	0.053*** [0.008]	0.009 [0.016]	0.064*** [0.009]	0.048*** [0.015]	0.051*** [0.011]
Cubic spline	0.030* [0.015]	0.058*** [0.006]	0.043*** [0.009]	0.055*** [0.011]	0.041*** [0.007]	0.062*** [0.010]	0.034 [0.024]	0.055*** [0.014]	0.069** [0.028]	0.062*** [0.016]
Cal. month dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample size	127,496	320,977	221,589	227,047	267,567	180,906	31,089	55,515	32,637	32,545
Mean of dep. variable	0.52	0.27	0.42	0.34	0.43	0.30	0.59	0.24	0.55	0.20

Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961. The dependent variable is an indicator variable for having achieved an educational attainment that allows a child to apply for entrance at a university. All regressions include 11 calendar month dummies. Regressions are restricted to children with certain background variables, which are defined in Table 1.

Appendix Table 2

Reduced-form estimates for the effect of the 1973 educational reform on actual attendance of university by different groups.

Coefficient on actual university attendance	Rural born		Born poor region		Born rural and poor region		Mother primary education	Mother primary education	Father primary education	Father primary education
	No (1)	Yes (2)	No (3)	Yes (4)	No (5)	Yes (6)	No (7)	Yes (8)	No (9)	Yes (10)
Linear	0.004 [0.004]	-0.001 [0.002]	0.000 [0.002]	-0.001 [0.002]	0.000 [0.002]	-0.001 [0.002]	0.015* [0.008]	-0.002 [0.002]	0.005 [0.009]	0.004 [0.003]
Quadratic	0.004 [0.004]	-0.001 [0.001]	0.000 [0.002]	-0.001 [0.002]	0.000 [0.002]	-0.001 [0.002]	0.015* [0.008]	-0.002 [0.002]	0.005 [0.009]	0.004 [0.003]
Cubic	-0.006 [0.005]	0.000 [0.002]	-0.004 [0.003]	-0.001 [0.002]	-0.003 [0.003]	-0.001 [0.003]	0.017 [0.010]	0.002 [0.003]	0.010 [0.011]	0.002 [0.004]
Linear spline	0.004 [0.004]	-0.001 [0.001]	0.000 [0.002]	-0.001 [0.002]	0.000 [0.002]	-0.001 [0.002]	0.015* [0.008]	-0.002 [0.002]	0.005 [0.009]	0.004 [0.003]
Quadratic spline	-0.007 [0.006]	-0.001 [0.002]	-0.006* [0.003]	-0.001 [0.003]	-0.004 [0.003]	-0.002 [0.003]	0.019 [0.012]	0.003 [0.004]	0.014 [0.012]	0.002 [0.005]
Cubic spline	0.008 [0.007]	-0.005 [0.003]	-0.003 [0.005]	0.000 [0.004]	0.002 [0.004]	-0.007 [0.005]	0.017 [0.014]	0.002 [0.007]	0.022 [0.016]	0.005 [0.007]
Cal. month dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample size	127,496	320,977	221,589	227,047	267,567	180,906	31,089	55,515	32,637	32,545
Mean of dep. variable	0.19	0.05	0.11	0.07	0.12	0.05	0.21	0.03	0.18	0.02

Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961. The dependent variable is an indicator variable for having graduated from university. All regressions include 11 calendar month dummies. Regressions are restricted to children with certain background variables, which are defined in Table 1.

Appendix Table 3

Reduced-form estimates for the effect of the 1973 educational reform by gender.

Coefficient on AFTER	Male	Male
	Sample: eligibility to attend university (1)	Sample: actual attendance of university (2)
Linear	0.024*** [0.006]	0.011 [0.012]
Quadratic	0.024*** [0.005]	0.009 [0.011]
Cubic	0.028*** [0.007][0.012]	0.007
Linear spline	0.025*** [0.005]	0.010 [0.011]

Appendix Table 3 (continued)

Coefficient on AFTER	Male	Male
	Sample: eligibility to attend university (1)	Sample: actual attendance of university (2)
Quadratic spline	0.032*** [0.007]	0.009 [0.013]
Cubic spline	0.023** [0.018]	0.026 [0.010]
Cal. month dummies	Y	Y
Sample size	169,450	40,135
Mean of dep. variable	0.48	0.54

Notes: Robust standard errors in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. Samples include cohorts born between January 1, 1956 and December 31, 1961 who achieved an educational attainment that allows them to apply for entrance at a university (column 1) and who graduated from university (column 2). The dependent variables is an indicator variable for being male. Each cell corresponds to a separate regression and presents the coefficient on AFTER in Eq. (2). AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958. All regressions include 11 calendar month dummies.

Appendix Table 4

Robustness checks for eligibility to attend university.

	Rural born (1)	Born poor region (2)	Born rural and poor region (3)	Mother primary education (4)	Father primary education (5)
<i>Panel A: Alternative windows</i>					
1 year window	0.045** [0.016] 0.041***	0.028** [0.011] 0.020**	0.039*** [0.012] 0.025***	0.053*** [0.019] 0.057***	0.061*** [0.018] 0.053***
2 year window	[0.006] 0.042***	[0.008] 0.022***	[0.007] 0.028***	[0.012] 0.049***	[0.011] 0.035***
4 year window	[0.004]	[0.006]	[0.005]	[0.008]	[0.008]
<i>Panel B: Placebo year cutoffs</i>					
1957	0.007 [0.016]	0.012 [0.013]	0.011 [0.014]	−0.009 [0.013]	0.049** [0.018]
1958	0.011 [0.016]	0.001 [0.015]	0.008 [0.012]	0.004 [0.021]	0.031** [0.012]
<b>1959</b>	<b>0.045**</b> <b>[0.016]</b>	<b>0.028**</b> <b>[0.011]</b>	<b>0.039***</b> <b>[0.012]</b>	<b>0.053***</b> <b>[0.019]</b>	<b>0.061***</b> <b>[0.018]</b>
1960	−0.008 [0.009]	0.019 [0.011]	0.016 [0.011]	−0.010 [0.016]	0.001 [0.019]
1961	0.005 [0.015]	−0.006 [0.007]	−0.001 [0.012]	−0.027 [0.016]	0.006 [0.015]

Notes: Robust standard errors are provided in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. In Panel B, samples include cohorts born 1 year on either side of the cutoff. The dependent variables are defined in Table 1. All regressions include a quadratic in month of birth and calendar of month dummies, except for the 1 year window which only includes a quadratic in month of birth. Each cell corresponds to a separate regression and presents the coefficient on AFTER in Eq. (2). AFTER is defined as 1 for individuals born on or after January 1 of the respective year and 0 for individuals born on or before December 31 of the previous respective year. The bold face coefficients represent our main effects (as opposed to the placebo effects).

Appendix Table 5

Robustness checks for actual attendance of university.

	Rural born (1)	Born poor region (2)	Born rural and poor region (3)	Mother primary education (4)	Father primary education (5)
<i>Panel A: Alternative windows</i>					
1 year window	0.010 [0.029] 0.011	0.023 [0.018] 0.011	0.012 [0.020] 0.002	−0.004 [0.036] −0.019	0.026 [0.027] 0.007
2 year window	[0.013] 0.011	[0.014] 0.002	[0.013] 0.004	[0.021] 0.005	[0.019] 0.020
4 year window	[0.009]	[0.010]	[0.009]	[0.014]	[0.013]
<i>Panel B: Placebo year cutoffs</i>					
1957	0.012 [0.026]	−0.001 [0.023]	0.012 [0.022]	−0.037 [0.043]	0.036 [0.022]
1958	0.003 [0.023]	0.008 [0.021]	0.013 [0.020]	−0.007 [0.039]	−0.013 [0.026]
<b>1959</b>	<b>0.010</b> <b>[0.029]</b>	<b>0.023</b> <b>[0.018]</b>	<b>0.012</b> <b>[0.020]</b>	<b>−0.004</b> <b>[0.036]</b>	<b>0.026</b> <b>[0.027]</b>
1960	0.011 [0.027]	0.004 [0.022]	0.018 [0.021]	0.007 [0.028]	0.035 [0.021]
1961	0.002 [0.027]	0.003 [0.018]	0.004 [0.013]	−0.033 [0.021]	−0.042** [0.020]

Notes: Robust standard errors are provided in brackets. All regressions are clustered by month of birth. \*\*\*, \*\* and \* indicate statistical significance at the 1, 5 and 10% level respectively. In Panel B, samples include cohorts born 1 year on either side of the cutoff. The dependent variables are defined in Table 1. All regressions include a quadratic in month of birth and calendar of month dummies, except for the 1 year window which only includes a quadratic in month of birth. Each cell corresponds to a separate regression and presents the coefficient on AFTER in Eq. (2). AFTER is defined as 1 for individuals born on or after January 1 of the respective year and 0 for individuals born on or before December 31 of the previous respective year. The bold face coefficients represent our main effects (as opposed to the placebo effects).

## References

- Aakvik, A., Salvanes, K.G., Vaage, K., 2010. Measuring heterogeneity in the returns to schooling in Norway using educational reforms. *European Economic Review* 54 (4), 483–500.
- Bound, John, Turner, Sarah, 2007. Cohort crowding: how resources affect collegiate attainment. *Journal of Public Economics* 91 (5–6), 877–899.
- Braham, R.L., 1972. *Education in Romania: A Decade of Change*. US Government Printing Press.
- Braham, R.L., 1978. *The Educational System of Romania*. US Government Printing Press.
- Brunello, G., Ariga, K., Giannini, M., 2006. The optimal timing of school tracking. In: Peterson, P., Wößmann, L. (Eds.), *Schools and the Equal Opportunity Problem*. MIT Press, Cambridge MA.
- Card, D., Dobkin, C., Maestas, N., 2008. The impact of nearly universal insurance coverage on health care utilization and health: evidence from Medicare. *The American Economic Review* 98 (5), 2242–2258.
- Carniero, P., Heckman, J., 2002. The evidence on credit constraints in post-secondary schooling. *Economic Journal* 112, 705–734.
- Dinardo, J., Lee, D., 2004. Economic impacts of new unionization on private sector employers: 1984–2001. *Quarterly Journal of Economics* 119 (4), 1383–1441.
- Duflo, E., P. Dupas, M. Kremer (forthcoming). Peer effects, pupil–teacher ratios, and teacher incentives: evidence from a randomized evaluation in Kenya, *American Economic Review*.
- Dustmann, C., 2004. Parental background, secondary school track choice, and wages. *Oxford Economic Papers* 56, 209–230.
- Florian, V., Serbanescu, C., 1998. Food consumption and rural poverty in Romania during transition to market. In: Mergos, G. (Ed.), *Agricultural Price Reform under Transition in Bulgaria, Romania, and Slovenia*. CIHEAM-IAMC, pp. 223–232.
- Hahn, J., Todd, P., van der Klaauw, W., 2001. Identification and estimation of treatment effects with a regression discontinuity design. *Econometrica* 69 (1), 201–209.
- Hanushek, E., Wößmann, L., 2006. Does educational tracking affect performance and inequality? Differences-in-differences evidence across countries. *Economic Journal* 116, 63–76.
- Heckman, J.J., 2004. “Human Capital Policy” in *Inequality in America: What Role for Human Capital Policies?* In: Friedman, B. (Ed.), MIT Press, Cambridge, MA.
- Krueger, A., 2004. Inequality, too much of a good thing. In: Friedman, B. (Ed.), *Inequality in America: What Role for Human Capital Policies?* MIT Press, Cambridge, MA.
- Imbens, G.W., Lemieux, T., 2008. Regression discontinuity designs: a guide to practice. *Journal of Econometrics* 127 (2), 615–635.
- Lee, D., Mccrary, J., 2005. Crime, Punishment, and Myopia. NBER Working Paper No. 11491.
- Lee, D., Card, D., 2007. Regression discontinuity inference with specification error. *Journal of Econometrics* 142 (2), 655–674.
- Malamud, O., Pop-Eleches, C., 2010. General education vs. vocational training: evidence from an economy in transition. *The Review of Economics and Statistics* 92 (1), 43–60.
- Manning, A., Piskche, J.S., 2006. Comprehensive versus selective schooling in England in Wales. What Do We Know? IZA Discussion Paper No. 2072.
- Maurin, E., McNally, S., 2007. Educational Effects of Widening Access to the Academic Track. A Natural Experiment. IZA Discussion Paper No. 2596.
- Meghir, C., Palme, M., 2005. “Educational reform, ability and parental background”. *American Economic Review* 95 (1), 414–424.
- Pekkarinen, Uusitalo, Pakkala, 2009. School tracking and intergenerational income mobility: evidence from the Finnish comprehensive school reform. *Journal of Public Economics* 93 (7–8), 965–973.
- Romanian Government, 1973. Resolution of the Communist Party’s Central Committee of June 18 and 19, 1973, Editura Politica, Bucharest Romanian Government, Annual Statistics of the Socialist Republic of Romania 1960–1980.
- Romanian Government, 1960–1980. Annual Statistics of the Socialist Republic of Romania.
- Shavit, Y., Blossfeld, H., 1993. *Persistent Inequality: Changing Educational Attainment in Thirteen Countries*. Westview Press, Boulder, Colo.
- Waldinger. 2007. “Does ability tracking exacerbate the role of family background for students’ test scores” mimeo. University of Warwick.