General versus Vocational Education: Lessons from a Quasi-Experiment in Croatia

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Abstract

This paper evaluates whether more years of general education makes individuals more adaptable on the labor market in a post-transition country. Using high school educational reform implemented in Croatia in 1975/76 and 1977/78 as a quasi-natural experiment we circumvent the issue of self-selection into the type of high school. In particular, high school education was split in two phases which resulted in reduced tracking and extended general curriculum for pupils attending vocational training. Exploiting rules on elementary school entry and timing of the reform, we use a regression discontinuity design and pooled Labor Force Surveys 2000-2012 to identify the causal effect of additional years of general education on educational decisions as well as on labor market outcomes measured as wages, total years of work, employment and activity status. We find that the reform, on average, reduced the probability of finishing high school, but did not change individuals' labor market perspectives. We conclude that the observed general-vocational wage differential is mainly driven by self-selection into the type of high school.

Keywords: general education, vocational training, reform.

JEL codes: I21, J24, P20.

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1 Introduction

The debate on general versus vocational education has been an important part of policy makers' and academics' agenda. As both educational systems have their benefits, there exists a well known general-vocational trade-off. In particular, skills acquired by vocational training may ease the transition into the labor market, but may become obsolete at a faster rate; while general education gives access to broader knowledge that can serve as a sound basis for subsequent learning and specialization (Hanushek et al., 2011). Verhaest and Baert (2015) characterize general versus vocational schooling as a trade-off between lower risk of bad match persistence later on, and higher employment chance and better match at the start of the career.

Some authors claim that general education is especially important for the fast-changing economy, as individuals can change occupations and adapt new technologies more quickly (Goldin, 2001; Hanushek et al., 2011). Adopting this view suggests that more general education should pay a labor market premium in transition and post-transition countries. With the fall of communism and establishment of market oriented economies in the 1990s, countries of Eastern block went through profound institutional and political changes. The economy was affected drastically as business activities turned to different sectors and technologies. These changes required a different set of skills on the labor market. Was more general education beneficial for individuals in this changing age? In particular, is there an observable premium on the labor market for additional years of general education in a post-transition country?

To provide answers to these questions is not an easy task as educational choice suffers from self-selection issues; comparing labor market outcomes of individuals with general and vocational education would reflect unobserved differences across individuals making the estimates biased.

In this paper we identify the causal effect of two additional years of general education in post-transition Croatia. To circumvent the self-selection of educational choice, we exploit a high school educational reform which was implemented in 1975/76 and 1977/78. In particular, high school education was split in two phases - the first phase, two years of general curriculum common to all students regardless of school enrolled, and a second phase, which prepared students for a particular profession. This introduced two novelties. Firstly, separation into vocational tracks was postponed, i.e. tracking was reduced. Secondly, individuals could not enter a vocational school directly after an eight-year compulsory elementary school; instead they needed to attend two additional years of general education. New educational rules were compulsory, and entrance into the reform was implicitly based on age. Exploiting elementary school age entry rules and the timing of the implementation of reform we are able to use regression discontinuity design on pooled Labor Force Surveys 2000 - 2012.

We test whether two additional years of general education changed educational decisions in terms of highest educational attainment, years of schooling and field of study as well as the effect on wages, years of work, employment and inactivity. Results indicate that the reform, on average, reduced the probability of finishing high school as fist-phase dropouts were common. Given the general curriculum administrated at the first phase, lower ability students, which could have finished three-year vocational high school before the

reform, had problems finishing the first phase. Therefore, we observe a decrease in the portion of individuals finishing three-year vocational high school and an increase in the portion of people with elementary school as a highest educational attainment. In line with these results, we also find that a portion of individuals were shifted from engineering, manufacturing and construction programs to general programs, as elementary school programs are coded as general programs.

Restricting our sample on non-gymnasium high school graduates we find that two additional years of general education did not significantly affect individuals' labor market prospectives. This lack of premium on more general education is surprising, given the potential upward bias of the estimates. In particular, as the reform caused increased incidence of high school dropouts, non-gymnasium high school sample contains different ability distributions before and after the reform. We conclude that the observed general vocational wage differential is mainly driven by self-selection into the type of high school.

These results are in line with other research that identify causal effect of more years of general education. Using educational reform in the 1970s in Romania, Malamud and Pop-Eleches (2010) find that more years of general education did not affect labor market participation and earnings. Oosterbeek and Webbink (2007), analyzing the reform of Dutch vocational schools, also find no evidence on premium on more general years of schooling. Analyzing a pilot scheme administrated in Sweden that introduced more comprehensive upper secondary education, Hall (2012) finds no effect of more general education on university enrollment and earnings, as well as no evidence that attending general education reduces unemployment risk during 2008-2010 crisis (Hall, 2013).

The rest of the paper is organized as follows: section 2 explains the educational reform in Yugoslavia, and hence Croatia, section 3 explains methodology and data, section 4 presents results while section 5 concludes.

2 Educational reform in Yugoslavia

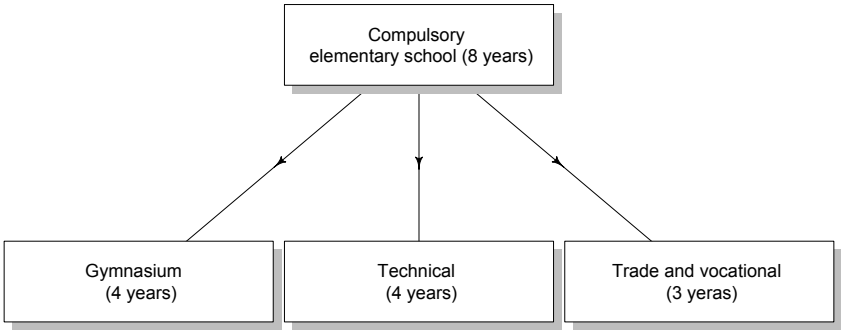
Prior to the reform in the 1970s, education in Yugoslavia, and hence Croatia, was regulated at the federal level by the General Law on Education from 1958. Children enrolled in an eight-year compulsory elementary school, on average, at the age of seven. After completion of elementary school, depending on their performance and aptitude, they enrolled in one of the following secondary schools: gymnasium, art school, technical school, trade or vocational school, teacher's school and military secondary school. Duration of secondary school depended on the type of the school, ranging from three years for trade or vocational schools for skilled workers to five years for teachers, but averaging around four years. After successfully finishing high school and earning a diploma, pupils could enroll in a higher educational institution or enter the labor market (Georgeoff, 1982).

On the tenth Congress of the League of Yugoslav Communists in 1974 the basis for so called 'directed' education was established. Objectives of the reform were: (i) a more equal distribution of students from various socio-economic backgrounds enrolled in secondary schools of various types; (ii) a greater emphasis on the

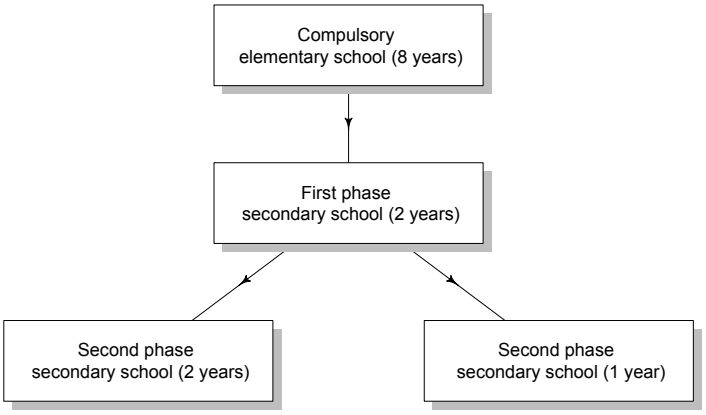
development of specific occupational skills with the goal of easier school to work transition; (iii) a promotion of greater equality of access to education and employment opportunities; and (iv) a closer integration of the schooling system with the needs of the social system an self-management (Obradović, 1986).

Figure 1: Changes in high school education in Croatia during 1975/76 and 1977/78 reform

(a) Before the 1975/76 and 1977/78 reform



(b) After the 1975/76 and 1977/78 reform



The reform redesigned mostly secondary education: high school was split in two phases. The first phase, which lasted for two years, was common for all students irrespective of the type of secondary school they enrolled. Majority of first phase curriculum was general (85%, Obradović (1986)): official language, chemistry, biology, physics, geography, mathematics and history. Selection into the first phase was based on elementary school performance. After completion of the first phase students could enter the labor market or continue to the second phase. The second phase was designed to provide vocational preparation. Depending on the profession, program lasted for one or two years. Programs for general education were still available (gymnasium) but they were also given vocational or paraprofessional context. All students who finished first phase could apply for any of the second phase programs, but selection was based on the grades in the first

phase. The first phase of the new high school system was implemented in all secondary education in Croatia in the school year 1975/76, for the first year high school students, while the second phase was implemented in the school year 1977/78 (UNESCO, 1977). Stylized representation of the reform is depicted in Figure 1. The reform introduced few important changes. Firstly, all pupils had to finish general-curriculum first phase, which resulted in later separation into vocational tracks. The first and second phase could have been attended at the same school (so-called school center). After elementary school individual could have applied to a particular school center, which was specialized to provide training for a specific profession. After finishing general-curriculum first phase in a school center, an individual could have applied for a second phase in a different school center, specialized for providing training for a different profession. The selection was based on the performance in the first phase. Although pupils were separated in the first phase making classes homogeneous in the fist phase, pupils could move to a different school center after the first phase which facilitated socio-economic mobility[1]. We thus interpret this change as a reduction in tracking.

As the first phase consisted of mostly general curriculum, pupils were able to make their educational choice two years later, which implies reduced tracking. For example, an individual who set their mind to become a carpenter, in a old educational system, would make that decision after eight years of elementary school by enrolling three year vocational school. In the reformed system, an individual could decide to become a carpenter, enroll the first phase, but then, after being exposed to general subjects, could change mind and apply for a different vocational program. Therefore, introducing one additional decision in secondary education - decision after the first phase, thus reducing tracking, might lead to a change of an educational choice.

The second change was that students were prevented to enter vocational training straight after elementary school. Instead, they needed to go through two additional years of general education before specializing for a particular vocation. This implied that, for example, an individual who would enroll three year vocational program before the reform would have eight years of general education, while the same person in the same vocational program after the reform would have ten years of general education (the discontinuity in the years of general education is depicted in Figure 2).

3 Methodology and data

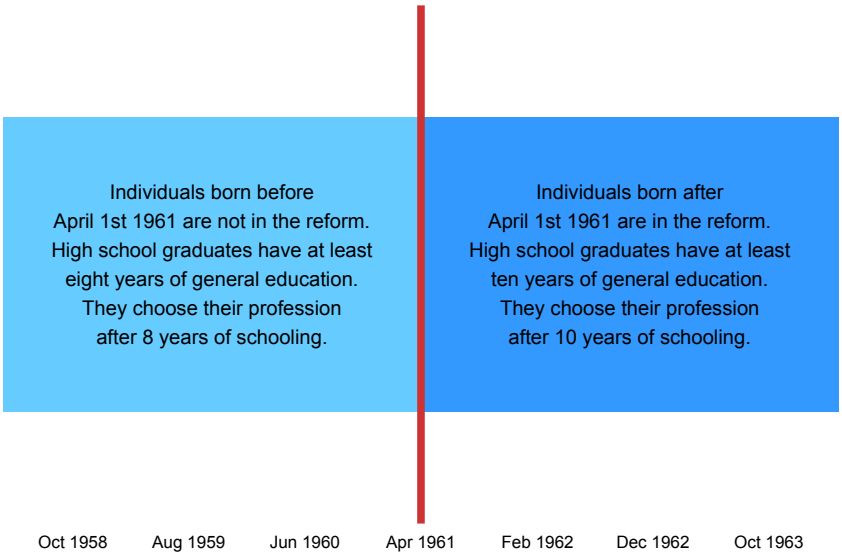
3.1 Methodology

Bennell (1996) claims that the majority of studies that assess general and vocational education in developing countries disregard the issues of selection bias. To circumvent the self-selection nature of an educational choice, and hence bias ordinary least squares estimates, we exploit the high school educational reform. The first stage of reform was implemented in the academic year 1975/76 for high school freshmen. As the usual high school starting age in Croatia was 15, the date of birth can provide information whether an

[1]For a survey on tracking literature in economics see Betts et al. (2011).

individual was included in the reform. In particular, using the rules for elementary school entry, we identify an individual born on April 1 1961 as an individual who was marginally included in the reform. Figure 2 depicts this discontinuity in the reform inclusion.

Figure 2: Discontinuity in reform inclusion



This framework enables us to use regression discontinuity design (RDD), introduced into economics literature by Thistlethwaite and Campbell (1960), where date of birth of each individual is used to construct an assignment variable that discontinuously determines reform inclusion. Suppose c_i is the distance, in weeks, between individual's i birth date and April 1 1961, and let $AFTER_i = \mathbb{1}[c_i \geq 0]$, i.e. an indicator taking value 1 if individual i was born after April 1 1961. In order to estimate the effect of additional years of general education on labor market outcome y_i, we estimate:

$$y_i = \beta' X_i + f(c_i) + \delta AFTER_i + \nu_i \tag{1}$$

where X_i is a vector of controls (intercept and predetermined variables, such as gender and nationality), $f(c_i)$ a function of an assignment variable and δ is a causal parameter of interest. In order to assess the effect of reduced tracking we define educational attainment, years of schooling and field of finished education as y_i's, while in order to assess causal effect of more general education we take log hourly wages, total years of work, employment and activity status as labor market outcomes. In order to avoid misinterpreting nonlinearities around the cutoff as discontinuities, caution regarding functional form of $f(c_i)$ is advised (Angrist and Pischke, 2008). Following Lee and Lemieux (2010) we estimate equation 1 parametrically and nonparametrically. In parametric setting we model $f(c_i)$ using polynomials of different order and different ad hoc bandwidths, while in nonparametric setting, we estimate equation 1 with local linear regression using

bandwidth selection procedure from Imbens and Kalyanaraman (2012).

Regression discontinuity designs rely on the assumption that individuals cannot precisely manipulate their assignment variable and thus completely control their assignment to the treatment (Lee and Lemieux, 2010). As the educational reform was announced in 1974 and implemented in the academic year 1975/76, and the assignment variable is predetermined, it seems rather implausible that individuals could manipulate inclusion into the reform. Nevertheless, we perform sorting test from McCrary (2008) to see whether grouping of individuals one side of the cutoff is present. Results indicate no sorting, so we conclude that the reform did randomly split the population and thus can be viewed as a quasi-experiment.

Relationship between the assignment variable and treatment status might not be deterministic, there might be non-compliers, i.e. there might be individuals who should, based on date of birth, have been included in the reform, but were not. Given that we do not have access to information whether an individual was indeed included in the reform, we cannot exploit assignment variable as an instrument for reform participation. Therefore, in order to deal with potential non-compliers we provide additional results using the so called donut regression discontinuity design (Barreca et al., 2011). The idea of this method is to exclude the observations that are just around the cutoff point of the assignment variable and re-run the whole procedure. In our case, this would imply that we are to exclude individuals that are certain number of weeks around the threshold date of April 1 1961, thus creating a so called donut hole.

3.2 Data

Data are obtained by pooling 2000-2012 versions of Croatian Labor Force Survey (LFS). LFS contains data on basic demographic characteristics, labor market outcomes, education variables (years of schooling, type of program finished, field of finished education), and date of birth which we use to construct an assignment variable for the regression discontinuity design. Giving the lack of longitudinal dimension we are unable to measure impact across life cycle. Also as we do not record whether an individual was included into the reform, so we cannot resort to instrumental variable estimation. We also do not capture information on a school center individual attended and whether an individual changed school center between phase one and two.

Table 1 presents descriptive statistics of pooled data. Note that we restrict sample to individuals born within three years around the cutoff date of April 1st 1961. We do so to restrict sample to cohorts that cope with similar labor market conditions upon finishing education. We also use other ad hoc bandwidths as a robustness check. Left panel of Table 1 displays cohort-restricted data on the individuals with all educational attainments (N=22,367), which will be used for the analysis of reduced tracking - whether postponing separation of student into vocational tracks affected highest educational attainment, years of schooling and field of finished education. Right panel of Table 1 displays cohort-restricted data on individuals with non-gymnasium secondary education (N=12,778), which will be used for the analysis of two extra years of general education in vocational programs.

Table 1: Descriptive statistics

	Whole sample (N=22,367)		Secondary education (N=12,778)	
	Mean	Std. dev	Mean	Std. dev.
Predetermined variables				
Female	0.459	0.498	0.424	0.494
Non-Croatian	0.081	0.273	0.081	0.274
Years of schooling				
$<$ 8 years	0.022	0.147	0	0
8 years	0.169	0.375	0	0
9 years	0.003	0.059	0	0
10 years	0.011	0.104	0	0
11 years	0.209	0.407	0.364	0.481
12 years	0.389	0.488	0.636	0.481
13 years	0.009	0.094	0	0
14 years	0.069	0.253	0	0
15 years	0.007	0.085	0	0
16 years	0.088	0.283	0	0
$>$ 16 years	0.023	0.150	0	0
Education level				
No elementary	0.022	0.146	0	0
Elementary	0.179	0.383	0	0
Vocational (3 years)	0.275	0.446	0.464	0.499
Vocational (4 years)	0.315	0.464	0.536	0.499
Gymnasium	0.028	0.165	0	0
Some university	0.074	0.262	0	0
University and more	0.108	0.310	0	0
Field of education*				
General programs	0.228	0.420	0	0
Teacher training	0.037	0.189	0.006	0.080
Humanities	0.011	0.106	0.006	0.080
Foreign languages	0.001	0.101	0.000	0.015
Social sciences	0.200	0.300	0.240	0.427
Life sciences	0.019	0.136	0.020	0.141
Biological sciences	0.001	0.030	0.000	0.018
Physical sciences	0.010	0.101	0.013	0.115
Mathematics	0.001	0.036	0.001	0.029
Computer science	0.003	0.055	0.003	0.051
Computer use	0.000	0.019	0.001	0.023
Engineering	0.317	0.465	0.474	0.499
Agriculture	0.029	0.167	0.035	0.183
Health care	0.054	0.227	0.061	0.239
Services	0.104	0.306	0.157	0.364
Labor market outcomes				
Log hourly wage	2.950	0.767	2.980	0.623
Years of work	22.7	6.02	23.2	5.64
Employed	0.793	0.405	0.825	0.380
Non-Active	0.014	0.116	0.013	0.115

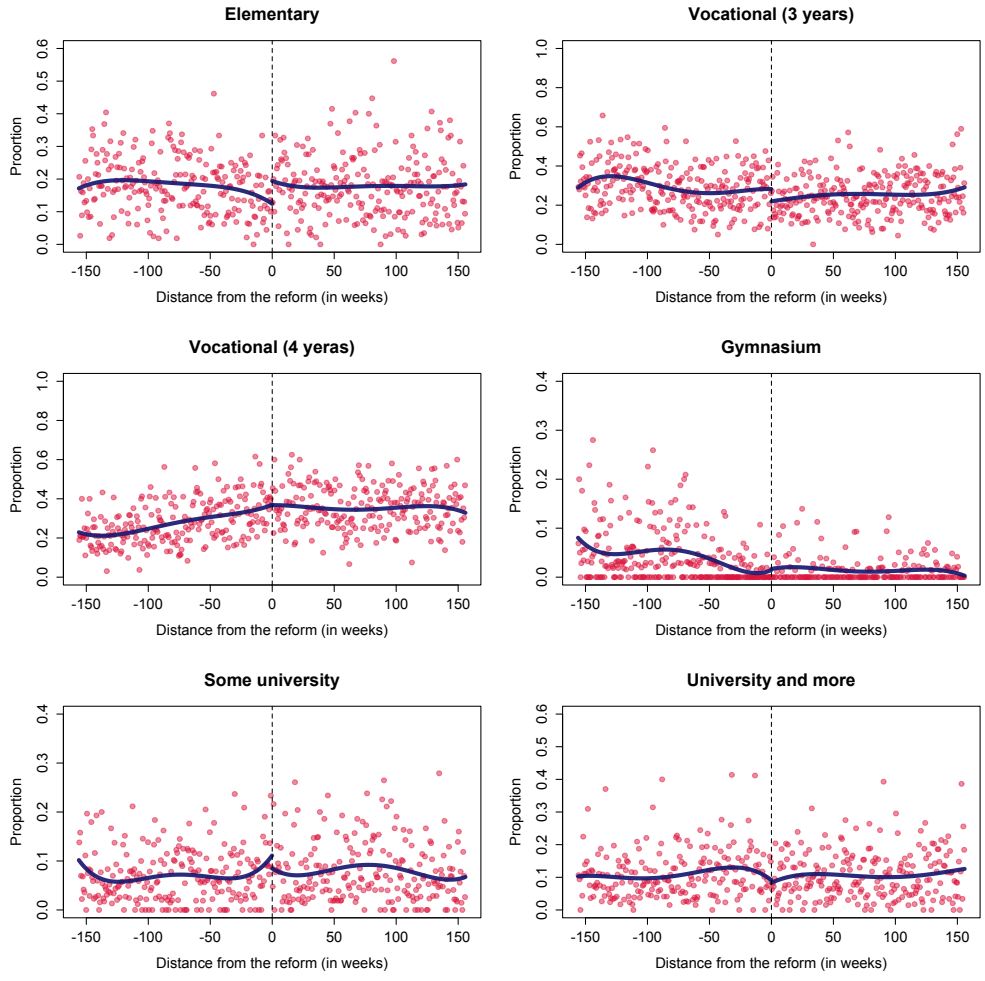
Note: Both samples are restricted to individuals born between April 1 1958 and April 1 1964. Secondary education sample is restricted to non-gymnasium high school graduates. * question regarding field of finished education is available in Labor Force Surveys 2004 onwards; sample size of whole sample is $N = 16,642$, while for the secondary education sample is $N = 9,548$.

4 Results

4.1 Reduced tracking and educational decisions

In this section we present results on whether splitting high school education into two phases, and thus reduced tracking, changed educational decisions. Due to data limitations, we cannot observe the portion of students that changed the school center after the first phase. However, given the fact that the reform randomly split population, we can compare highest educational attainment, years of schooling and field of finished education before and after the reform. We present our results graphically and using RDD regressions. Figure 3 and Table 2 display the results for the highest educational attainment.

Figure 3: RDD graphs for finished education



Note: Sample is restricted to individuals born from April 1 1958 to April 1 1964. Solid blue line represents fourth order polynomial estimation of $f(c_i)$. Number of bins is chosen using evenly-spaced mimicking variance method from Calonico et al. (2015).

Graphs on Figure 3 indicate that the introduction of the two-phased high school resulted in an increase of portion of individuals that finished elementary school and a drop of portion of individuals that finished

three-year vocational high school. Given that other educational attainment do not display discontinuous break, we conclude the reform shifted a portion of people from three-year vocational to elementary school. This shift can be explained by the fact that three-year vocational schools are, on average, attended by lower ability pupils, which resulted in high first stage dropout rates.

Table 2: Results for highest educational attainment

	Finished education					
	Elementary	Vocational (3 years)	Vocational (4 years)	Gymnasium	Some university	University and more
3 year window (N=22,367)						
Linear spline	0.021	−0.019	−0.0003	0.005	0.007	−0.023
	(0.016)	(0.018)	(0.021)	(0.006)	(0.011)	(0.014)
Quadratic spline	0.047**	−0.037	−0.004	0.020**	−0.023	−0.019
	(0.023)	(0.025)	(0.031)	(0.008)	(0.016)	(0.021)
Cubic spline	0.055*	−0.090***	0.021	0.028***	−0.019	−0.015
	(0.030)	(0.032)	(0.039)	(0.010)	(0.022)	(0.025)
Quartic spline	0.072**	−0.064*	−0.004	0.003	−0.028	−0.007
	(0.036)	(0.037)	(0.042)	(0.012)	(0.026)	(0.030)
2 year window (N=15,094)						
Linear spline	0.032*	−0.027	−0.006	0.017**	−0.011	−0.019
	(0.019)	(0.021)	(0.025)	(0.007)	(0.014)	(0.017)
Quadratic spline	0.055*	−0.076***	0.023	0.023**	−0.019	−0.023
	(0.028)	(0.029)	(0.037)	(0.010)	(0.020)	(0.024)
Cubic spline	0.061*	−0.069*	−0.003	0.004	−0.023	0.002
	(0.034)	(0.036)	(0.042)	(0.012)	(0.025)	(0.029)
Quartic spline	0.108***	−0.057	−0.053	0.013	−0.038	0.008
	(0.040)	(0.043)	(0.046)	(0.013)	(0.030)	(0.033)
1 year window (N=7,534)						
Linear spline	0.043	−0.063**	0.006	0.014*	−0.015	−0.011
	(0.027)	(0.027)	(0.034)	(0.008)	(0.019)	(0.023)
Quadratic spline	0.101***	−0.072*	−0.018	0.013	−0.036	−0.008
	(0.036)	(0.039)	(0.041)	(0.012)	(0.027)	(0.030)
Cubic spline	0.052	−0.007	−0.033	0.008	−0.015	−0.008
	(0.038)	(0.041)	(0.047)	(0.014)	(0.033)	(0.035)
Quartic spline	0.079	−0.006	0.020	0.003	−0.073*	−0.009
	(0.049)	(0.052)	(0.059)	(0.012)	(0.037)	(0.043)

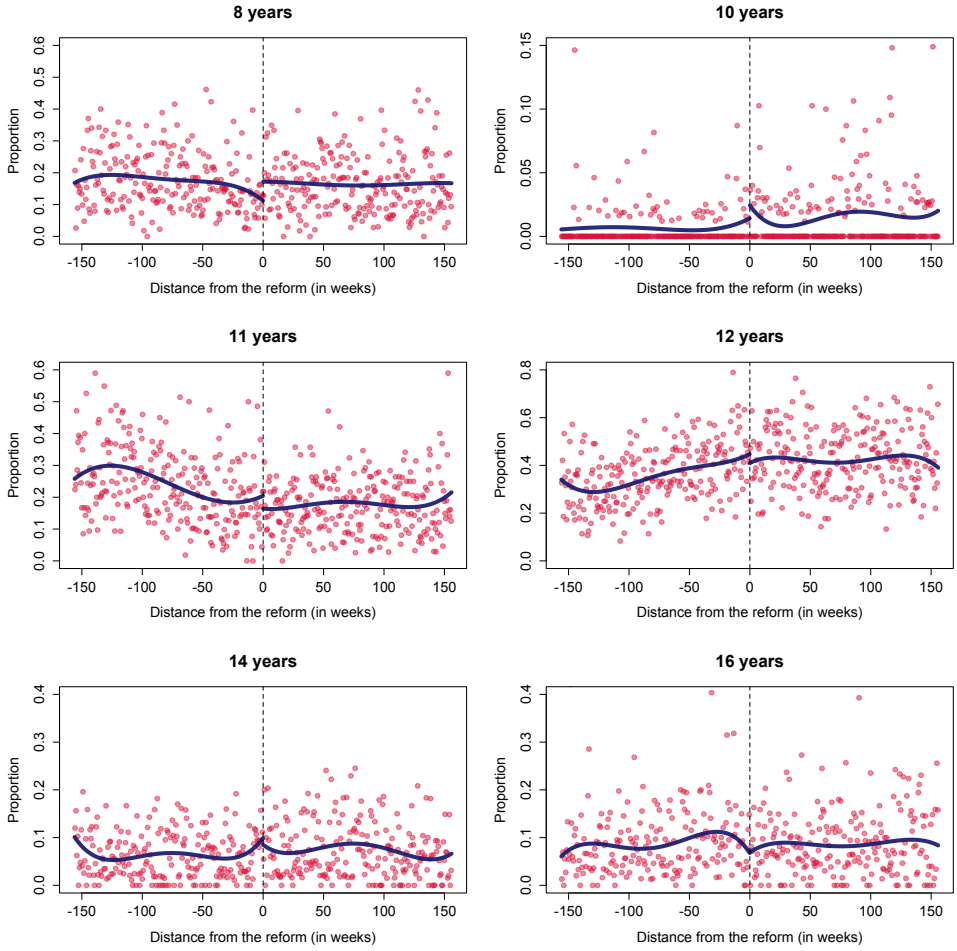
Note: Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. Window width denotes ± years around the cutoff date. Covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

This conclusions are supported with results presented in Table 2. In most of model specifications - using different bandwidths and different functional forms of $f(c_i)$, reform induced significantly higher probability of finishing only elementary school. Significant coefficients vary from 0.032 to 0.108, which implies that the introduction of two-phased high school caused an increase in probability of finishing only elementary school from 3.2 to 10.8 percentage points. At the same time, half of the model specifications for three-year vocational high school indicate a significant negative effect varying from -0.090 to -0.063. Some of the specifications also indicate higher probability of finishing gymnasium, although coefficients are smaller in magnitude.

Next, we turn to analysis of schooling years - Figure 4 and Table 3. Graphically, the most apparent break is the on the portion of individuals who have eight years of schooling, which supports first phase dropout interpretation. The same can be read from Table 3, the probability that an individual will finish only eight years of elementary school increases for 3.2 to 11.2 percentage points.

Figure 4: RDD graphs for schooling years



Note: Sample is restricted to individuals born from April 1 1958 to April 1 1964. Solid blue line represents fourth order polynomial estimation of $f(c_i)$. Number of bins is chosen using evenly-spaced mimicking variance method from Calonico et al. (2015).

Table 3: Schooling years

	Total years of education				
	8 years	11 years	12 years	14 years	16 years
3 year window (N=22,367)					
Linear spline	0.019	−0.001	−0.014	0.015	−0.021
	(0.016)	(0.018)	(0.022)	(0.011)	(0.014)
Quadratic spline	0.046**	0.002	−0.026	−0.011	−0.020
	(0.023)	(0.028)	(0.034)	(0.015)	(0.020)
Cubic spline	0.050*	−0.056	0.009	−0.008	−0.011
	(0.030)	(0.034)	(0.043)	(0.021)	(0.025)
Quartic spline	0.062*	−0.041	−0.039	−0.015	0.002
	(0.036)	(0.040)	(0.047)	(0.024)	(0.030)
2 year window (N=15,094)					
Linear spline	0.032*	0.002	−0.019	−0.001	−0.022
	(0.019)	(0.023)	(0.028)	(0.013)	(0.016)
Quadratic spline	0.051*	−0.040	0.008	−0.009	−0.015
	(0.028)	(0.032)	(0.041)	(0.019)	(0.023)
Cubic spline	0.051	−0.041	−0.049	−0.010	0.005
	(0.034)	(0.040)	(0.046)	(0.024)	(0.029)
Quartic spline	0.112***	−0.029	−0.099**	−0.013	0.002
	(0.040)	(0.045)	(0.050)	(0.027)	(0.034)
1 year window (N=7,534)					
Linear spline	0.040	−0.029	−0.019	−0.003	−0.009
	(0.026)	(0.030)	(0.038)	(0.018)	(0.022)
Quadratic spline	0.094***	−0.046	−0.057	−0.017	−0.004
	(0.035)	(0.042)	(0.046)	(0.024)	(0.030)
Cubic spline	0.057	0.025	−0.072	−0.001	−0.013
	(0.039)	(0.047)	(0.053)	(0.032)	(0.037)
Quartic spline	0.075	0.009	0.003	−0.050	−0.024
	(0.051)	(0.060)	(0.069)	(0.037)	(0.048)

Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. Window width denotes ± years around the cutoff date. Covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

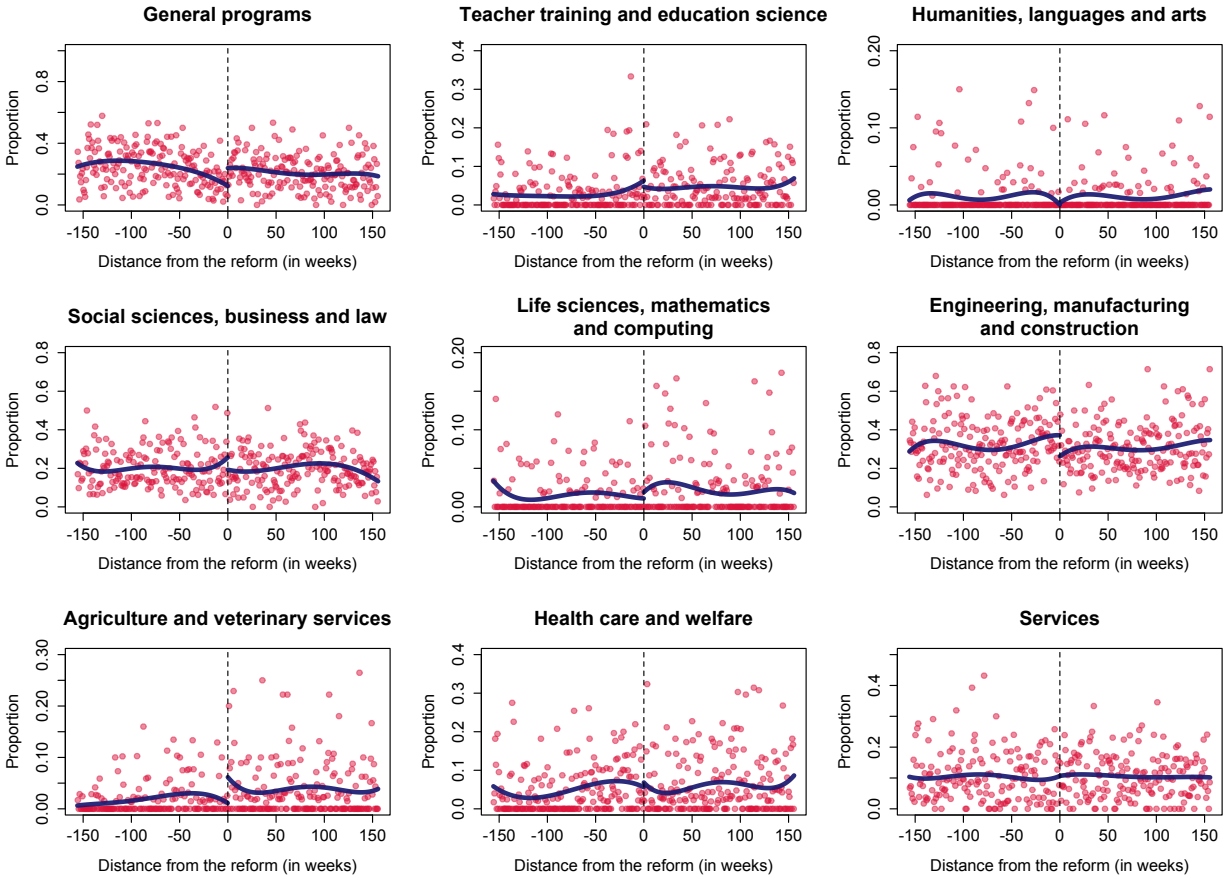
So far we have established that the introduction of the reform has induced higher probability of finishing only elementary school. We explain this with the increased dropout rates form the first phase, which lower ability students could not finish. Next, we turn to changes in the field of education. As already mentioned, we do not record the portion of students that changed school center after first stage. School changers are important as they might indicate that educational decision making process changed with the introduction of two-phased high school. For example, it is plausible that an individual, after being exposed to a general curriculum in the first phase, might have changed occupational decisions, and hence school center. Even if we do not have data on school center changers, we can see if there has been a shift in field of finished education, which indicates the effect of reduced tracking on an educational choice.

Figure 5 indicates that the largest breaks were in the general programs; engineering, manufacturing and construction and agriculture and veterinary services. This also supports the view that first phase dropouts were common. In particular, all individuals who have reported elementary schools as a highest education report their field of education as general. Therefore, increase in general programs reflects the increase of portion of people who finished only elementary school. This interpretation is supported by that fact that almost 27% of students failed to complete the first phase (Obradović, 1986).

The same argumentation holds for a drop in engineering, manufacturing and construction. 61.31% individuals who have finished three-year vocational high school report their field of education as engineering, manufacturing and construction; therefore a reduction of this educational field merely reflects a drop in three-year vocational schools.

This graphical results are supported with RDD regressions in Table 4 and 5. A significant increase of probability of finishing general program school is found in almost all specifications, where the probability increase varies from 4.9 to 15.5 percentage points. At the same time probability of finishing program in engineering, manufacturing and construction reduces between 4.9 and 10.5 percentage points. Also, the reform reduces the probability of finishing programs related to social sciences and health care.

Figure 5: RDD graphs for the field of finished education



Note: Sample is restricted to individuals born from April 1 1958 to April 1 1964. Solid blue line represents fourth order polynomial estimation of $f(c_i)$. Number of bins is chosen using evenly-spaced mimicking variance method from Calonico et al. (2015).

Table 4: Field of education

	Field of finished education				
	General	Teacher	Humanities	Social sciences	Life sciences
3 year window (N=16,642)					
Linear spline	0.049**	0.004	−0.003	−0.012	0.013*
	(0.022)	(0.010)	(0.006)	(0.023)	(0.007)
Quadratic spline	0.119***	−0.006	−0.0001	−0.059*	0.016
	(0.031)	(0.015)	(0.008)	(0.033)	(0.011)
Cubic spline	0.121***	−0.023	−0.003	−0.049	0.021
	(0.039)	(0.019)	(0.010)	(0.042)	(0.013)
Quartic spline	0.117**	−0.018	0.003	−0.076	0.007
	(0.046)	(0.022)	(0.012)	(0.049)	(0.015)
2 year window (N=11,236)					
Linear spline	0.089***	−0.002	−0.002	−0.036	0.019**
	(0.026)	(0.013)	(0.007)	(0.028)	(0.009)
Quadratic spline	0.121***	−0.021	−0.002	−0.048	0.013
	(0.037)	(0.018)	(0.009)	(0.039)	(0.012)
Cubic spline	0.106**	−0.012	0.005	−0.074	0.017
	(0.045)	(0.022)	(0.012)	(0.048)	(0.015)
Quartic spline	0.155***	−0.008	0.005	−0.164***	0.014
	(0.053)	(0.026)	(0.013)	(0.054)	(0.018)
1 year window (N=5,612)					
Linear spline	0.102***	−0.012	−0.001	−0.038	0.019
	(0.036)	(0.017)	(0.009)	(0.038)	(0.012)
Quadratic spline	0.155***	−0.014	0.009	−0.124**	0.004
	(0.047)	(0.023)	(0.013)	(0.049)	(0.016)
Cubic spline	0.052	−0.009	−0.007	−0.140**	0.027
	(0.049)	(0.031)	(0.011)	(0.060)	(0.021)
Quartic spline	0.112*	−0.027	−0.018*	−0.174**	0.026
	(0.067)	(0.035)	(0.011)	(0.075)	(0.028)

Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. Window width denotes ± years around the cutoff date. Covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

Table 5: Field of education

	Field of finished education			
	Engineering	Agriculture	Health care	Services
3 year window (N=16,642)				
Linear spline	−0.049**	0.011	−0.022*	0.009
	(0.021)	(0.038)	(0.012)	(0.021)
Quadratic spline	−0.074**	0.018	−0.031**	0.018
	(0.030)	(0.038)	(0.012)	(0.030)
Cubic spline	−0.104***	0.035	−0.012	0.014
	(0.039)	(0.038)	(0.012)	(0.039)
Quartic spline	−0.094*	0.050	0.011	−0.0005
	(0.050)	(0.038)	(0.012)	(0.050)
2 year window (N=11,236)				
Linear spline	−0.060**	0.015	−0.035***	0.012
	(0.025)	(0.038)	(0.012)	(0.025)
Quadratic spline	−0.105***	0.028	−0.009	0.022
	(0.036)	(0.038)	(0.012)	(0.036)
Cubic spline	−0.078	0.047	−0.007	−0.005
	(0.047)	(0.038)	(0.012)	(0.047)
Quartic spline	−0.099	0.067*	0.022*	0.008
	(0.063)	(0.038)	(0.012)	(0.063)
1 year window (N=5,612)				
Linear spline	−0.091***	0.031	−0.033***	0.024
	(0.034)	(0.038)	(0.012)	(0.034)
Quadratic spline	−0.093*	0.048	0.019	−0.005
	(0.051)	(0.038)	(0.012)	(0.051)
Cubic spline	−0.003	0.052	0.063***	−0.036
	(0.064)	(0.038)	(0.012)	(0.064)
Quartic spline	−0.003	0.066*	0.041***	−0.024
	(0.082)	(0.038)	(0.012)	(0.082)

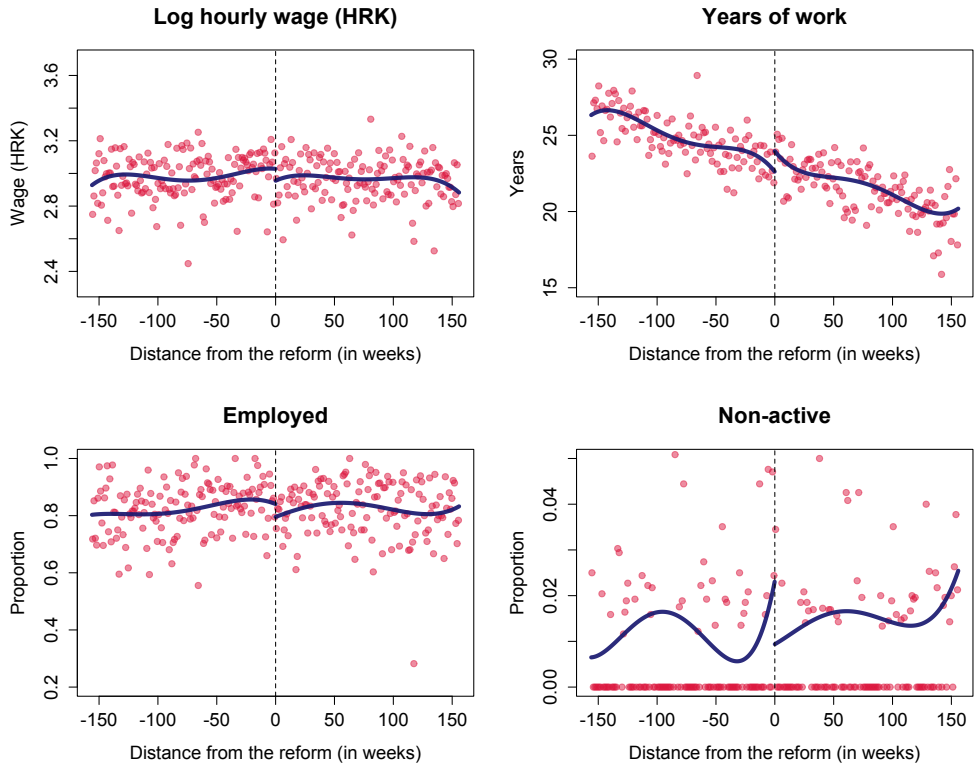
Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. Window width denotes ± years around the cutoff date. Covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

4.2 Labor market outcomes

Figure 6 present graphical regression discontinuity design for labor market outcomes - log hourly wage, years of work and employment and non-activity status; Table 6 presents results of parametric RDD, while Table 7 provides additional results - nonparametric RDD and donut RDD. Before interpreting the results, note that estimates are most likely upward biased. As seen in previous section, introduction of two-phased high school, were first phase is common to all students irrespective of school center and consists of mostly general curriculum, has increased the number of individuals who finish only elementary education. We explain this with high incidence of first phase dropouts. In this section we are estimating the effect of more general education for non-gymnasium high school graduates, thus correspondingly restricting sample. Given the high first phase dropout rates, after the reform, lower ability pupils are not included in the high school sample. Therefore, reform has excluded left tail of ability distribution among high school graduates thus making our RDD estimates upward biased.

Figure 6: RDD graphs for labor market outcomes



Note: Sample is restricted to individuals born from April 1 1958 to April 1 1964. Solid blue line represents fourth order polynomial estimation of $f(c_i)$. Number of bins is chosen using evenly-spaced mimicking variance method from Calonico et al. (2015).

Even having this in mind, as Figure 6 and Table 6 and 7 reveal no labor market premium on more years of general education. The coefficient on log hourly wages and employment status is negative, though insignificant. In some of the parametric versions of RDD years of work are significantly positively affected.

Robustness checks in Table 7, especially the parametric versions (donut hole RDD and restricting sample to crisis years) confirm this findings. This lack of premium on more general education is surprising, given the potential upward bias of the estimates. We conclude that, like in other studies that identify causal effect, the observed general vocational wage differential is mainly driven by self-selection into the type of high school.

Table 6: Labor market outcomes

	Labor market outcomes			
	Log hourly wages	Years of work	Employed	Non-Active
3 year window (N=12,778)				
Linear spline	−0.013	0.528**	−0.024	0.001
	(0.029)	(0.232)	(0.020)	(0.005)
Quadratic spline	−0.044	0.421	−0.051*	0.003
	(0.043)	(0.341)	(0.029)	(0.008)
Cubic spline	−0.055	0.338	−0.066*	−0.011
	(0.061)	(0.450)	(0.038)	(0.010)
Quartic spline	−0.070	1.170**	−0.042	−0.015
	(0.071)	(0.489)	(0.044)	(0.012)
2 year window (N=8,633)				
Linear spline	−0.032	0.328	−0.042*	0.002
	(0.035)	(0.272)	(0.023)	(0.007)
Quadratic spline	−0.038	0.611	−0.055	−0.003
	(0.056)	(0.404)	(0.035)	(0.010)
Cubic spline	−0.091	0.700	−0.046	−0.020
	(0.074)	(0.507)	(0.044)	(0.013)
Quartic spline	−0.074	1.120**	−0.048	−0.017
	(0.079)	(0.548)	(0.049)	(0.016)
1 year window (N=4,414)				
Linear spline	−0.067	0.301	−0.053	−0.002
	(0.049)	(0.393)	(0.032)	(0.009)
Quadratic spline	−0.046	0.962*	−0.043	−0.020
	(0.072)	(0.514)	(0.046)	(0.013)
Cubic spline	−0.026	2.080***	−0.029	−0.025
	(0.078)	(0.538)	(0.049)	(0.019)
Quartic spline	−0.116	2.810***	−0.024	−0.020
	(0.086)	(0.653)	(0.055)	(0.023)

Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. In all specifications sample is restricted to non-gymnasium high school graduates. Window width denotes ± years around the cutoff date. Covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

Table 7: Additional results

	Labor market outcomes			
	Log hourly wages	Years of work	Employed	Non-Active
Local linear regression				
IK bandwidth	-0.645^{***}	0.629	-0.364^{***}	0.063^{**}
	(0.242)	(1.810)	(0.082)	(0.031)
Observations	307	532	242	108
Half IK bandwidth	-0.435^{***}	1.697	-0.399	0.143^{**}
	(0.145)	(1.904)	(0.271)	(0.070)
Observations	155	270	99	73
Double IK bandwidth	-0.472^{***}	1.281	-0.256^{***}	0.072
	(0.155)	(1.270)	(0.098)	(0.046)
Observations	589	1044	490	258
3 year window with ± quarter donut hole (N=11,638)				
Linear spline	0.004	0.594^{**}	-0.023	0.008
	(0.034)	(0.281)	(0.023)	(0.007)
Quadratic spline	-0.025	0.391	-0.076^{**}	0.025^{**}
	(0.057)	(0.507)	(0.038)	(0.012)
Cubic spline	-0.034	-0.317	-0.157^{**}	0.016
	(0.103)	(0.922)	(0.069)	(0.024)
Quartic spline	-0.076	2.197	-0.169	0.040
	(0.171)	(1.585)	(0.114)	(0.041)
3 year window, crisis years (2009-2012) (N=4,428)				
Linear spline	-0.073	0.914^{*}	-0.067	0.010
	(0.060)	(0.478)	(0.043)	(0.012)
Quadratic spline	-0.155^{*}	1.046	-0.098	0.022
	(0.087)	(0.688)	(0.064)	(0.016)
Cubic spline	-0.171	0.668	-0.169^{*}	0.002
	(0.118)	(0.907)	(0.087)	(0.016)
Quartic spline	-0.192	2.042^{**}	-0.134	-0.017
	(0.140)	(0.986)	(0.101)	(0.014)

Note: Standard errors clustered at the week of birth are in brackets. Each cell represents different regression and presents the coefficient on variable AFTER which takes value 1 if individual was born after April 1, 1961, and 0 otherwise. For local linear regressions sample is restricted to non-gymnasium high school graduates. Local linear regressions are estimated using triangular kernel, while IK represents Imbens - Kalyanaraman optimal bandwidth. In 3 year window with ± one quarter donut hole sample is restricted to non-gymnasium high school graduates born between April 1 1958 and April 1 1964, excluding individuals born within one quarter around the cutoff date of April 1 1961. In a 3 year window with crisis years sample is restricted to non-gymnasium high school graduates born between April 1 1958 and April 1 1964 and surveys 2009 - 2012. In all models covariates include female and non-Croatian dummy as well as dummy for the survey year.

Significance levels: *p<0.1; **p<0.05; ***p<0.01

5 Conclusion

In this paper we identify the causal effect of two additional years of general education in post-transition Croatia. To circumvent the self-selection of educational choice, we exploit an educational reform that was implemented in 1975/76 and 1977/78. The reform redesigned mostly secondary education: high school was split in two phases. The first phase, which lasted for two years, was common for all students irrespective of the type of secondary school they enrolled. Majority of first phase curriculum was general and the selection into the first phase was based on elementary school performance. After completion of the first phase students could enter the labor market or continue to the second phase, which was designed to provide vocational preparation. Depending on the profession, the program lasted for one or two years.

The reform introduced few important changes. Firstly, students were separated into vocational tracks later, i.e. tracking was reduced. Secondly, individuals could not enter a vocational school directly after an eight-year compulsory elementary school; instead they needed to attend two additional years of general education. Exploiting rules on elementary school entry and timing of the reform, we use regression discontinuity design and pooled Labor Force Surveys 2000-2012 to identify the causal effect of additional years of general education on educational decisions as well as on labor market outcomes measured as wages, total years of work, employment and activity status.

Results indicate that the reform, on average, reduced the probability of finishing high school as fist-phase dropouts were common. Given the general curriculum administrated at the first phase, lower ability students, which could have finished three-year vocational high school before the reform, had problems finishing first phase. Therefore, we observe a reduced portion of individuals finishing three year vocational high school and increased portion of people with elementary school as a highest educational attainment. In line with these results, we also find that a portion of individuals were shifted from engineering, manufacturing and construction programs to general programs, as elementary school programs are coded as general programs.

Restricting our sample on non-gymnasium high school graduates, we find that two, additional years of general education did not significantly affect individuals' labor market prospectives. This lack of premium on more general education is surprising, given the potential upward bias of the estimates. In particular, as the reform has caused increased incidence of high school dropouts, non-gymnasium high school contains different ability distributions before and after the reform. These findings are are line with other studies that identify the causal effect of more general education. We conclude that observed general vocational wage differential is mainly driven by self-selection into the type of high school.

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