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The Outflow of High-ability Students from Regular Schools and Its Long-term Impact on Those Left Behind

Miroslava Federičová

CERGE-EI
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The outflow of high-ability students from regular schools and its long-term impact on those left behind[1]

Miroslava Federičová[2]

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Abstract

Early tracking school systems, which stream student by ability, are considered a trigger of widening inequality in education. However, more homogenous class composition resulting from ability tracking seem to improve efficiency of teaching and learning. Literature on peer effects shows contradictory findings about these two counteracting effects. This paper contributes to the discussion of the efficacy of ability tracking by examining the effects of the outflow of high-ability students after primary education on the long-term educational outcomes and behaviour of their peers who remain in regular classes. Exploiting a 2009 school reform in Slovakia which postponed tracking by one year, we show that the outflow of high-performing peers results in a weak negative long-run effect on non-tracked student's math scores and late arrivals at school, and more persistent negative effects on out-of-school study time.

JEL codes: I21, I24, I28

Key words: early-tracking school system, peer effects, gender effects, Slovak school reform

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[2] CERGE-EI, a joint workplace of Center for Economic Research and Graduate Education, Charles University and the Economics Institute of the Czech Academy of Sciences, Politických vězňů 7, P.O. Box 882, 111 21 Prague 1, Czech Republic.

1. Introduction

Early tracking school systems are among the issues often discussed by school policy experts. Tracking is generally considered to produce large inequalities in educational outcomes. The system introduces selection by academic ability at very early ages, and tends to reinforce the role of family background in school choices and educational opportunities (Betts 2011; Brunello and Checchi, 2007). Using geographic and time variations in implementation of school reforms in Sweden and Finland (Meghir and Palme, 2005; Pekkarinen, Uusitalo and Kerr, 2009)[3] and differences in tracking policies across European countries (Hanushek and Woessmann, 2006; Ammermueller, 2005), several empirical studies show that a more comprehensive school system reduces education inequality and intergenerational income transition.

Though previous literature has claimed that tracking increases inequality without having a positive effect on efficacy of teaching and learning (Hoffer, 1992), there is a new range of studies showing that low-achieving students are not negatively impacted by tracking (Betts and Shkolnik, 2000; Figlio and Page, 2002).[4] Hence, from the efficiency point of view, ability tracking's more homogenous class settings may help students to learn and teachers to teach.

The aim of this paper is to contribute to the discussion about the efficacy issue of tracking by examining the effects of changes in student class and school composition at early ages,

[3] Meghir and Palme (2005) use geographic variations in implementation of the school reform in Sweden, which postponed the first tracking from the sixth to the ninth grade. They found positive effects on school attendance and also on earnings for those whose fathers had low education. Pekkarinen, Uusitalo and Kerr (2009) exploit geographical and time variation in implementation of a similar de-tracking policy in Finland's school system and, examining the intergenerational income transition, find that this policy reduced the association between father´s and son´s earnings by 20 %.

[4] Rather than comparing the average effects, several studies further examine the non-linear effects of within-school tracking and show positive effects of tracking on high-ability minority students without any impact on students in lower (or regular) tracks (Card and Giuliano, 2016; Teajong, Ju-Ho and Young, 2008).

i.e., after the fourth grade of primary education. We focus on the effects of the outflow of high-ability students after primary education on the long-term educational behaviour and outcomes of their peers. We use a specific early tracking setting in the Slovak school system, in which high-achieving students can switch to selective schools after primary education, while the rest of the class remains in the same school until the end of the 9th grade. This system is notable for its low percentage of students leaving regular primary education and for low permeability across the selective and regular tracks. The combination of these two features creates a high degree of competition in the system, and thus potentially drives greater educational inequality. In order to measure the effects of the outflow of top students on the achievements and behaviour of the rest of a class, the study exploits a 2009 school reform in Slovakia, which postponed transition from primary schools to selective secondary schools, called Gymnazia, by one year, from the end of the fourth to the end of the fifth grade. After this reform, students in regular (non-selective) schools in Slovakia profited from studying an additional year with their high-achieving peers. Our hypothesis is that this additional year with strong peers could advantage the weaker students, especially in the sense of a greater focus on academic achievement and on responsible behaviour by students influenced by the stronger students, better class climate and social norms with positive long-term consequences.

The effects of a change in class composition from ability tracking; specifically, the effects of the outflow of high-ability students on their peers, is not clear, even after considering peer effects literature. Previous literature finds positive, though small effects of peer background on student outcomes (Ammermueller and Pischke, 2009; Hoxby, 2000;

Hanushek, Kain, Markman and Rivkin, 2003). These modest linear-in-means[5] peer effects are reinforced when the effects of a student´s own ability and those of overall ability changes in peer group composition are divided, however, there is no clear consensus in the literature.[6] The less controversial findings are only for peer effects on students' social outcomes and behaviour (Sacerdote, 2011). In this respect, studies concur, pointing to high peer effects on student behaviour, including drug and alcohol use, smoking, dropping out of school (Gaviria and Raphael, 2001; Powell, Tauras and Ross, 2005; Lazear, 2001), and on exacerbating a disruptive class environment (Lavy, Paserman and Schlosser, 2008; Lavy and Schlosser, 2011).

In contrast, examining a context with only a limited share of top students leaving the class after primary education in Hungary, Schiltz, Mazrekaj, Horn and De Witte (2019) show negative short-run effects on math test scores on the students left behind; but find no impact on reading scores, the behaviour of students (as evaluated by teachers), or student aspirations. The Hungarian school system is very similar to that in Slovakia, with students leaving primary school in order to enter a selective school after the sixth grade. However, rather than the short-run effects, i.e., the effects of two years, this paper studies the long-run effects of this outflow of the top students on those left behind. Moreover, we focus on the effects on undesirable student behaviour, such as grade repetition and arriving late to school, and on out-of-school study time.

[5] The linear-in-means model is used to measure peer effects estimating a student´s own outcomes by her background characteristics and peer´s average outcomes and background characteristics. The drawback of this model is that the size of the peer effects is independent of a student´s own ability or background (Sacerdote, 2011), i.e., it assumes the same peer effects on high and low achievers.

[6] Some studies find that all students, both low and high performers, profit from having high-ability peers in class (Hanushek, Kain, Markman and Rivkin, 2003), whereas Burke and Sass (2013) show that, for low-achievers, it is better to be in a class with peers of average ability than to be with top students. In contrast, Hoxby and Weinghart (2005) coincide with Duflo, Dupas and Kremer (2011) affirming that students profit more from homogenous classes.

Regarding student achievement, we find a weakly positive effect on their peers of the presence of high-ability students in primary education for one additional year, similar to findings by Schiltz, Mazrekaj, Horn and De Witte (2019). This is in line with the existing literature that shows very low linear-in-mean peer effects (Ammermueller and Pischke, 2009; Hoxby, 2000; Hanushek, Kain, Markman and Rivkin, 2003), and no clear findings when allowing for nonlinearities (Schneeweis and Winter-Ebmer, 2007; Burke and Sass, 2013). However, due to strong social interactions typically engaged in young teenagers, this additional year in an environment with academically stronger peers induces positive effects on student behaviour. We find strong positive peer effects on student out-of-school study time. The outflow of 10% of high-ability students in a district leads to a drop in out-of-school study time by their peers who remain in the regular school of two hours per week, five years later. This effect was found to be driven mainly by girls. Regarding deviate behaviour, the same outflow of students results in an 8 percentage points higher probability of late arrivals at school. These results seem to be robust when controlling for other possible changes in class composition between primary and lower-secondary education.

This analysis uses information from two waves of an international programme, PISA 2012 and 2015, which tested a cohort of 15-year-old students in math, reading, and science. Using PISA data, we focus on students in lower-secondary education. The majority are already in the 9th (final) grade. In 2012, these students had spent the past five years in class without the stronger peers, whereas students tested in PISA 2015 benefitted from one additional year with their stronger peers. To examine whether the additional year with stronger peers could produce positive long-lasting effects on student behaviour and achievement, we implement a difference-in-difference approach, using students in

the Czech Republic as a control group. This approach benefits from the similarity of the Czech and Slovak school systems. In the Czech Republic, school systems allow tracking after the first five grades of primary education, coinciding with the Slovak school system after the 2009 school reform. Even though the Czech and Slovak school systems are very similar, each country experiences differences in tracking policy across its districts. Around 5 % of districts in Slovakia and the Czech Republic have no selective school, but in around 3% of districts, there are huge outflows of high-achieving students, in some districts amounting to 15 or 20% of a given class. In our identification strategy, we also exploit this variation in the outflow rates of high-achieving students across Czech and Slovak districts and apply triple differences.

However, this approach has two main weaknesses. First, the outflow of high-ability students is measured from administrative data on a district level and further merged with PISA data. Thus, we do not observe the outflow of students from particular classes in the PISA sample, and we instead examine the intention-to-treat effects, which may underestimate the real average effects. On the other hand, our calculations may be overestimated by the overall drop in student outflow into selective schools in Slovakia as another consequence of the 2009 school reform. To account for these issues, we apply a robustness check using a unique, longitudinal student dataset CLoSE, which covers the period of the first tracking, i.e., the fourth to the ninth grade, in the Czech Republic. Thanks to the similarity of the school systems, we can again use the results from the Czech Republic as a robustness check for our DID strategy. These results show that the outflow of high-ability students seems to correlate with the drop in math scores and in self-confidence in math.

Despite extensive literature on peer effects, very little is known about the different reaction of girls and boys to changes in peer composition of their class. A recent study by Balestra, Sallin and Wolter (2021) finds a positive impact of stronger students on their peers' achievement and choice of high school track. They also point to a higher impact on male peers, regardless of the gender of the stronger students, while the impact on female peers was observed only from the effects of strong female students exiting the class. The other study examining heterogenous gender effects is related to the early-tracking literature. Again, using the change from early-tracking to a comprehensive school system in Finland, Pekkarinen (2008) shows that the change had a positive effect on the educational attainment of girls in academic upper secondary education, as well as in tertiary education. Girls, therefore, seem to accrue advantages from a comprehensive class composition during their primary and lower secondary education. To further illuminate gender differences in this topic, we examine the effects of the outflow of high-achieving students on their peers separately for girls and boys. Our results show that the effects on math test scores seems to be driven by girls, whereas the effects on self-confidence in math are mainly driven by boys.

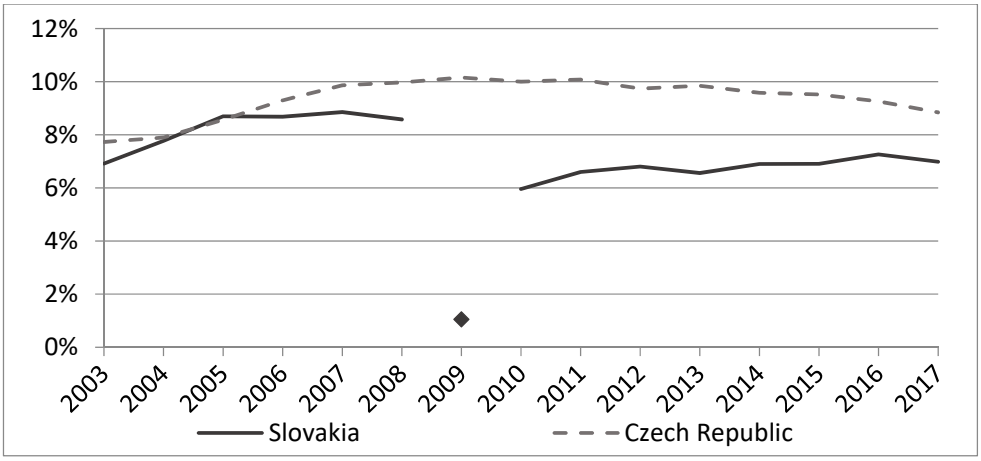
The paper is structured as follows. Section 2 describes the school system and tracking policy in Slovakia and the Czech Republic. Section 3 introduces the data and identification strategy. Section 4 discusses the results, and Section 5 concludes.

2. Institutional background

Tracking policies applied in many school systems basically divide students by ability or achievement into different classes or schools. Within-school tracking is very common in the United States and Canada, where students are streamed into different classes in the

same school according to their past ability. European countries generally apply between-school tracking, in which students are placed in different types of schools (academic or vocational high schools) so that students must also integrate into a new peer group at school. [7]

Figure 1: Proportion of students in the first grade of selective schools to the total number of students in the relevant age cohort



Source: Ministry of Education, Youth and Sports of the Czech Republic; Ministry of Education, Youth and Sports of Slovakia.
Note: Discontinuity present in time series is due to the 2009 school reform in Slovakia.

We focus on two European countries with early tracking school systems, Slovakia and the Czech Republic. In both countries, the first tracking occurs after the 5th grade, when most students are around the age of 11. At this point, students can apply for highly-selective schools that provide secondary education. Those who do not apply or are not admitted to the selective schools usually continue at the same regular school until the end of the 9th grade, and then choose between vocational or general educational tracks. This system is based on the German model of education and is very similar to other early

[7] For detailed analysis of tracking in education, see e.g., Betts (2011).

tracking systems, especially in Central Europe, e.g., in Austria, Germany, and Hungary. Selective schools are considered very prestigious, aiming to attract the top performers in primary education. They are highly selective and usually offer high-performing peers, better teachers and study environment, and more advanced curricula.

Table 1: Descriptive characteristics of those who stay in regular school, those who leave for a selective school, or for another regular school after the 5th grade, and new-comers to regular school in the 6th grade

Czech Republic	Stay in regular school		Leave for selective school		Leave for other regular school		New-comers to 6th grade	
	mean	sd	mean	sd	mean	sd	mean	sd
% Boy	0.53		0.44		0.56		0.55	
TIMSS score (4th grade)	-0.068	(0.96)	0.873	(0.75)	-0.265	(1.08)		
CLoSE score (6th grade)	-0.513	(0.73)					-0.501	(0.78)
Grade in math	1.90	(0.86)	1.14	(0.35)	2.09	(1.04)	1.96	(0.99)
Grade in Czech	2.05	(0.87)	1.26	(0.49)	2.26	(1.06)	2.11	(0.97)
Like Math	0.60	(0.49)	0.68	(0.47)	0.61	(0.49)	0.56	(0.50)
Like Czech	0.32	(0.47)	0.46	(0.50)	0.37	(0.48)	0.28	(0.45)
Satisfied with life	0.89	(0.31)	0.87	(0.34)	0.90	(0.30)	0.86	(0.35)
Future plans - University	0.48	(0.50)	0.90	(0.29)	0.49	(0.50)	0.60	(0.49)
Mother – university edu.	0.21	(0.41)	0.44	(0.50)	0.26	(0.44)	0.27	(0.44)
Father – university edu.	0.23	(0.42)	0.56	(0.50)	0.24	(0.43)	0.29	(0.46)
N	3163		406		431		965	

Source: CLoSE

Note: Characteristics are weighted according to the weights for the 5th grade (and weights for the 6th grade for newcomers). Grades in math and Czech language are measured on a 5-point scale, where 1 means the best and 5 the worst grade. Variable *Like Math*, *Like Czech* is a dummy variable equal to 1 for those who declared Math or Czech as the most popular or rather popular subject.

To examine the effects of high-performing students on their peers, this study takes advantage of a 2009 school reform in Slovakia[8]. One of the aims of this reform was to postpone the first tracking from the end of the fourth to the end of the fifth grade. Moreover, the reform set a more restricted limit on those tracked to 6% of all students in the respective cohort.[9] After the reform, students in primary school profited from an additional year in class together with their best peers. The 2009 school reform occurred only in Slovakia and shifted the tracking in such a way that, after the reform, the timing of tracking coincided with tracking in the Czech Republic.

In order to obtain better information about students who switch to selective schools, we further exploit unique student data from a longitudinal Czech study, CLoSE. CLoSE followed the cohort of 4th graders in TIMSS[10] testing in 2011, and provides detailed information about students in the 4th, 5th, 6th and 9th grades. Using this information, we can see which students switched to selective schools, and the new-comers into 6th grade in regular schools, who are mostly entering from another primary school. Detailed information about class composition in the 5th grade and changes after tracking (in Table 1) confirms that students who switch to selective schools change the class composition and environment. Selective school students have, by almost 1 standard deviation point on average, higher math test scores than students who stay in regular schools. They earn generally higher grades and are more likely to say that they like studying math and Czech.

[8] The reform was instigated by the School Act No. 245/2008 Coll. in 2008. This reform was a part of the National Millennium programme of 2001, which set the direction of the Slovak school system for the next 20 years. The first postponement of tracking in Slovakia was implemented in 2009. As a consequence of this reform, in the school year 2009/2010, no students were tracked to selective schools and no new classes were opened.

[9] See Figure 1 for the time change in the proportion of pupils in the highly-selective schools in Slovakia and the Czech Republic.

[10] TIMSS (Trends in International Mathematics and Science Study) tests students in the fourth grade in math and science.

90% of those who moved to a selective school want to continue studies in university, in comparison to only 48% of those who remain in regular schools. They also tend to have better socio-economic backgrounds in terms of their parents´ highest education. Table 1 also shows that new-comers into the 6th grade in regular schools are, on average, very similar to students who studied in that school from the 1st grade, and thus do not replace the high-achieving peers in an academic achievement sense. Those who leave a regular school at the end of their primary education to enter another regular lower-secondary school are very similar in all characteristics to students who in the same school. The quality of students in this additional outflow at the end of primary school thus does not mimic the quality of the outflow of students to selective schools.

3. Data and methodology

To examine the effects of the outflow of high-achieving students on the educational outcomes and academic behaviour of their peers, we use data from the PISA international testing programme, which tests 15-year-old students in mathematics, reading, and science skills in three-year cycles. We take advantage of two cycles, PISA 2012 and 2015. PISA 2012 tested 15-year-old Slovak students who were not affected by the school reform (they had already started 7th grade when the reform was implemented on 4th graders), so they spent five years in lower-secondary education without their high-performing peers. Students in Slovakia tested in PISA 2015 were, however, affected by the 2009 school reform. In comparison to the previous cohort, they attended fifth grade with all of their peers from primary education, and at the end of the school year, a percentage of their high-achieving colleagues left to enter a selective school.

Table 2: Descriptive statistics of student and school background characteristics; ninth graders in regular schools

	Slovakia		Czech Republic	
	2012	2015	2012	2015
Standardized math test score	-0.13	-0.11	0.19	0.10
	(1.10)	(1.08)	(0.92)	(0.92)
Out-of-school study time per week (hours)	7.1	19.7	7.0	17.0
	(6.5)	(15.1)	(6.6)	(12.6)
Repeat grade (at least once)	7.2 %	6.7 %	5.3 %	4.8 %
Late for school (at least once in last two weeks)	24.2 %	36.3 %	25.6 %	51.8 %
Sex (% of boys)	54.0	54.2	57.6	55.2
Age (years)	15.6	15.6	15.6	15.6
	(0.25)	(0.23)	(0.24)	(0.24)
Mother – university education (%)	19.1	26.4	21.8	18.5
Father – university education (%)	15.9	22.1	20.5	19.0
Books at home (%)				
0-10 books	27.1	23.1	12.2	14.3
11-25 books	18.0	19.1	15.7	18.0
26-100 books	32.4	31.0	35.4	33.3
101-200 books	12.8	15.0	18.1	18.0
201-500 books	6.9	6.9	12.7	10.8
more than 500 books	2.8	4.9	5.9	5.6
Municipality size of school location (%, approximate)				
fewer than 3,000 residents	33.2	37.7	15.0	22.5
3,000 to a15,000	34.4	25.1	30.0	29.6
15,000 to 100,000	26.1	28.4	30.9	32.0
more than 100,000	6.3	8.8	24.1	15.9
% of students in schools offering only primary education (district level)	11.8 %	11.9 %	13.8 %	14.9 %
Outflow of students (district level)	8.3 %	6.0 %	10.2 %	9.0 %
Number of observations	1,633	2,460	1,701	2,220

Source: PISA 2012 and 2015

Note: Standard deviations for selected characteristics are in parenthesis. In the Czech Republic, the percentage of students who were late for school at least once in the past two weeks doubled between PISA 2012 and 2015. We checked the Czech translation of this question in the two PISA waves and they are the same.

In addition to the test of math skills, the PISA survey offers data from detailed student and school questionnaires. These allow us to also study the effects of the outflow of high-

achieving students on student academic behaviour. We examine the effects on repeating a grade, the numbers of late arrivals to school, and students´ out-of-school study time measured in hours. Descriptive statistics for student and school characteristics are documented separately for Slovakia and the Czech Republic, and for both observed periods, 2012 and 2015, in Table 2. These statistics reveal that Czech students are slightly stronger in math than Slovak students, however, they are similar in the amount of time they devote to out-of-school study, and also terms of their late arrivals to school, at least in 2012.

3.1 Empirical strategy

Our identification strategy is based on a quasi-experimental design employing the 2009 school reform in Slovakia. As the result of this reform, the first tracking was shifted by one year, and this shift produced an exogenous change in the presence of high-achieving students in 5th grade classes. Our key hypothesis is that the additional year students spent with high-achieving peers may impact several outcomes: reduce undesirable student behaviour, increase their out-of-school study time, and help them to perform better in math.

In order to examine the effects of this reform, and to control for trends in student educational outcomes, attitudes, and behaviour unrelated to the reform during the observed period, we exploit two strategies. First, we use the Czech Republic as a control group for the treatment – the 2009 school reform – in Slovakia. The two countries have very similar education systems.[11] Second, the model accounts for variation in the outflow

[11] For a discussion about the similarity of the school systems in the two countries after the dissolution of Czechoslovakia in 1993, see Federičová and Munich (2017).

rates of high-achieving students across Czech and Slovak districts, leading to the following difference-in-difference-in-difference model:

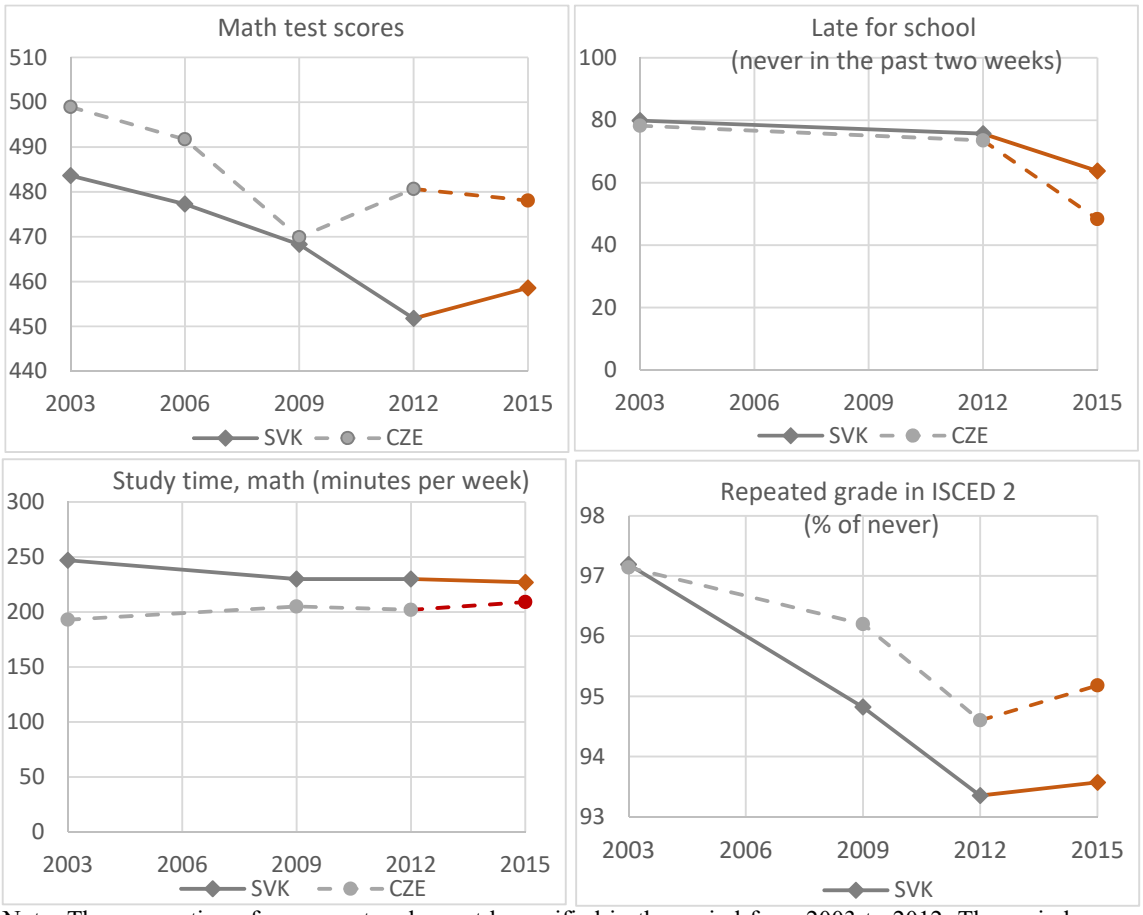
$$Y_{itd} = \beta_0 + \beta_1 Year^{2012} \times SVK + \beta_2 Year^{2012} \times SVK \times Outflow_{d,2012} + \beta_3 X_{it}^{'} + \beta_4 Year^{2012} \times Outflow_{d,2012} + \beta_5 SVK \times Outflow_{d,2012} + \beta_6 Outflow_{d,2012} + \gamma Year^{2012} + \delta \ SVK + \varepsilon_{itd} \quad (1)$$

, where *Y* is the dependent variable (i.e., PISA math score, student behaviour, and out-of-school study time), of student *i* in year *t* and in district *d*; *Year*^{2012} is a time dummy variable equal to 1 for 2012 (the period before the reform); SVK is a dummy variable equal to 1 for Slovakia and 0 for the Czech Republic, and *Outflow* is the outflow rate of high-achieving students to selective schools in district *d* in 2012. The model further controls in *X* for student observed characteristics (age, gender, the number of books at the student's home, the highest achieved education of parents) and one school characteristic (the size of the municipality in which the school is located). Coefficients β_1 and β_2 are the key coefficients of our interest. The coefficient on the interaction term between treatment and outflow (β_2) captures a change in the variable of interest due to the greater number of students who left a class for selective schools. We also estimate the model separately for girls and boys to allow for possible heterogenous gender effects.

To use the Czech Republic as a control group for Slovakia, the assumption of common trends in test scores and other variables examined must be satisfied. Essentially, if the Slovak reform had not occurred, all dependent variables should have followed the same trends in the Czech Republic and Slovakia as before. To examine this hypothetical situation, we verify the common trend assumption in the period before the reform in our key variables from PISA. For this purpose, Figure 2 depicts time trends in PISA math test

scores and student characteristics for Slovakia and the Czech Republic in 2003, 2006, 2009, 2012 and 2015. The period between the last two years, marked in red, should be affected by the 2009 school reform in Slovakia. In overall, we can confirm from the Figure that the two countries were following similar trends in all variables before 2012.[12]

Figure 2: Time trends in math test scores and other dependent variables in the Czech Republic and Slovakia



Note: The assumption of common trends must be verified in the period from 2003 to 2012. The period between 2012 and 2015 (in red) might be already affected by the Slovak reform. These trends use data only for 15-year-old students in ISCED 2, i.e. in grades 7, 8, and 9.

[12] The results in mathematics for the Czech Republic in 2009 appear to be inconsistent with other waves of PISA. This discrepancy may have been caused by a measurement error. However, this have no impact on the main results of this paper, as it is focused on the period 2012 and 2015. Since the results in 2012 followed the same trend as in years 2003 and 2006, we would further assume that math test scores meet the common trend assumption.

As we observe only 15-year-old students and their corresponding classes, we have no information about class composition before the outflow of the high-performing peers. The rate of outflow is therefore approximated by the rate of outflow on the district level, which allows us to measure only the intention-to-treat effects.

4. Results

Using a 2009 Slovakian educational reform which postponed early-tracking by one academic year, we identify the effects of the outflow of high-achieving students after primary education on their peers in two steps. First, we take advantage of the similarity of Slovakia and the Czech Republic, and use the Czech Republic as a control group for the treatment in Slovakia. Second, we exploit the variation of the outflow of high-achieving students across Slovak and Czech districts, leading to the triple difference model set in Equation 1. Results of this two-step procedure are presented in Table 3, in which the treatment variable is the dummy for Slovakia in 2012, and in the second step, its interaction with the variation in outflow of high-achieving students.

The first three columns of the Table 3 account only for the 2009 reform in Slovakia. The first column examines the whole sample, and the second and third columns estimate the effects separately for girls and boys. Separate parts of Table 3 successively study the effects on math test scores[13], out-of-school study time measured in hours, repeating a grade, and late arrivals to school as variables of student behaviour. The absence of high-performing students significantly decreases the study time of their peers and increases late arrivals. However, there is no impact of the absence of the best peers on the repeat grade rate, nor on student achievements on the PISA math test.

[13] The effects on reading and science test scores are presented in Table A1 in Appendix.

In the last three columns, we further exploit the variation in the outflow of high-performing students across Czech and Slovak districts, again for the whole sample and separately for girls and boys in columns (5) and (6). Math scores are again unaffected. In the case of student study time, we observe no difference in districts with zero outflow before and after the reform. However, study time significantly decreases for students who experienced higher outflows of their best peers. The effect of an additional year spent with the best peers is also positive in the case of late arrivals to school, whereas there is again no effect on grade repetition, probably due to its low variation across students.

Regarding the different effects on girls and boys, exploiting the variation of the outflow, the results indicate that its overall negative effect on study time is driven mainly by girls. When the outflow of better peers increases, girls significantly decrease their study time, though boys seem to be unaffected in this respect. Late arrivals at school show similar results, in line with Pekkarinen (2008), who shows that girls tend to benefit from comprehensive school systems, without any selective tracking during the primary and lower secondary education.

Table 3: Impacts of the outflow of high-achieving students from class (students in the Czech Republic as a control group)

Whole sample	(1) All	(2) Girls	(3) Boys	(4) All	(5) Girls	(6) Boys
Math score						
Treatment	0.036	0.103	-0.011	0.129	0.124	0.138
(SVK x 2012)	(0.081)	(0.097)	(0.087)	(0.160)	(0.188)	(0.172)
Treat x Outflow				-1.267	-0.140	-2.122
				(1.425)	(1.674)	(1.544)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	8014	3557	4457	8014	3557	4457
R^2	0.243	0.274	0.215	0.244	0.274	0.217

Study time						
Treatment	-2.288***	-1.596**	-3.038***	-0.457	0.876	-2.048
(SVK x 2012)	(0.654)	(0.776)	(0.842)	(1.088)	(1.262)	(1.495)
Treat x Outflow				-19.791*	-28.882***	-8.672
				(10.089)	(11.065)	(15.450)
Controls						
N	6296	2843	3453	6296	2843	3453
R^2	0.188	0.151	0.221	0.188	0.152	0.221
Repeat grade						
Treatment	-0.002	-0.009	0.003	0.011	0.018	0.005
(SVK x 2012)	(0.013)	(0.016)	(0.017)	(0.021)	(0.028)	(0.026)
Treat x Outflow				-0.172	-0.354	-0.012
				(0.184)	(0.248)	(0.250)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	7447	3282	4165	7447	3282	4165
R^2	0.079	0.094	0.071	0.080	0.095	0.072
Late for school						
Treatment	0.156***	0.165***	0.146***	0.120**	0.134**	0.109*
(SVK x 2012)	(0.025)	(0.034)	(0.032)	(0.050)	(0.064)	(0.061)
Treat x Outflow				0.482	0.390	0.512
				(0.431)	(0.542)	(0.583)
Controls	Yes	Yes	Yes	Yes		
N	7827	3469	4358	7827	3469	4358
R^2	0.077	0.072	0.080	0.078	0.072	0.081

Note: Standard errors are robust to clustering at the year and district level in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). All specifications control for individual characteristics (age, sex, parent's education, and books at home) and school characteristic (the size of the municipality in which the school is located). *Math score* is a standardized PISA math test score, *Study time* is out-of-school study time per week measured in hours, *Repeat grade* and *Late for school* are 0/1 variables indicating whether student repeated a grade in ISCED 2 or whether he/she was late for school in the prior two weeks.

The composition of a class after the first five years of primary education can vary for other reasons than the outflow of pupils into selective schools. A source of new inflows to lower-secondary regular track classrooms are pupils from basic schools that offer only

primary education. This is more common for schools in small villages. In the Czech Republic and Slovakia, there are several less-populated regions that in some areas offer only primary education, after which students move to lower-secondary schools in a nearby town or village.[14] The proportion of schools offering only primary education in a given region may additionally change class composition during lower-secondary education, and hence, have an effect on our previous results. We use this new information about Czech and Slovak districts, and target only districts in which the class composition changes primarily due to outflow of students into selective schools. We restrict our sample to districts with fewer than 15 % of pupils attending schools that offer only primary education.[15]

Table 4 shows the results for this restricted sample. These results remain in the same direction as those for the whole sample, however, with somewhat higher magnitude in the case of math scores and out-of-school study time. This is in line with the finding that new-comers to a 6th grade class do not offset the loss of high-performing students, and that, on average, they are very similar to students who remained in the regular school.

Accounting for the treatment effect and its interaction with the rate of outflow of better peers, students in a class from which, e.g., 10% of their best peers left to attend a selective school, experience a fall in math scores at the end of lower-secondary education of around 0.2 standard deviation in comparison to students in the same cohort but in a class from

[14] There were, on the average, 12 % (12 %) and 14 % (15 %) of pupils in schools offering only primary education in the school year 2006/07 (2009/10) in Slovakia and the Czech Republic.
[15] This threshold of 15% is set according to the average number of pupils attending schools offering only primary education. As a robustness check, we further examine different threshold points: 10%, 12%, 18% and 20%. The estimated effects are in line with the main findings presented in the paper. These results are available upon request.

which no one left. The outflow of high-achieving peers seems to have the same effects on girls and boys.

Table 4: The impact of an outflow of high-achieving students from class, using only districts with fewer than 15% of students in schools offering only primary education (the first five years)

Restricted sample	(1) All	(2) Girls	(3) Boys	(4) All	(5) Girls	(6) Boys
Math score						
Treatment	0.131	0.194*	0.092	0.342**	0.449**	0.265
(SVK x 2012)	(0.095)	(0.116)	(0.105)	(0.164)	(0.199)	(0.192)
Treat x Outflow				-2.194*	-2.356	-2.009
				(1.299)	(1.621)	(1.402)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	4942	2206	2736	4942	2206	2736
R^2	0.204	0.246	0.166	0.206	0.249	0.168
Study time						
Treatment	-2.123**	-1.349	-2.815**	0.491	1.953	-0.852
(SVK x 2012)	(0.850)	(0.978)	(1.127)	(1.528)	(1.797)	(2.111)
Treat x Outflow				-24.374**	-33.847***	-15.647
				(11.955)	(12.604)	(19.237)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	3952	1800	2152	3952	1800	2152
R^2	0.177	0.140	0.211	0.178	0.141	0.212
Repeat grade						
Treatment	0.003	-0.019	0.021	0.014	0.010	0.016
(SVK x 2012)	(0.014)	(0.018)	(0.018)	(0.027)	(0.035)	(0.032)
Treat x Outflow				-0.118	-0.321	0.067
				(0.190)	(0.266)	(0.235)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	4630	2052	2578	4630	2052	2578
R^2	0.064	0.078	0.059	0.064	0.078	0.059

Late for school						
Treatment	0.145***	0.163***	0.126***	0.071	0.094	0.054
(SVK x 2012)	(0.032)	(0.043)	(0.041)	(0.060)	(0.081)	(0.078)
Treat x Outflow				0.843*	0.749	0.863
				(0.451)	(0.589)	(0.657)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	4856	2171	2685	4856	2171	2685
R^2	0.074	0.069	0.078	0.076	0.069	0.080

Note: Standard errors are robust to clustering at the year and district level in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). All specifications control for individual characteristics (age, sex, parent's education, and books at home) and a school characteristic (the size of the municipality in which the school is located). *Math score* is a standardized PISA math test score, *Study time* is out-of-school study time per week measured in hours, *Repeat grade* or *Late for school* are 0/1 variables indicating whether a student repeated a grade in ISCED 2 or whether he/she was late for school in the prior two weeks.

An increasing outflow of high-achieving students has also negative significant effects on late arrivals to school and study time. The outflow of 10% of students from a primary class into a selective school leads to a reduction in study time of around two hours per week on average. In contrast to the math score, this effect is primarily driven by girls, who reduce their out-of-school study learning time by three hours per week.

An outflow of high-achieving peers from a class again has no effect on the repeat grade rate. On the other hand, exploiting the variation of the outflow of students, we find a significant negative effect on late arrivals. These increase by around 8% in districts with 10% outflow rates in comparison to districts with no selective school (and thus zero outflow).

4.1 Robustness check

In previous analyses, we examine the intention-to-treat effects, as we observe the outflow of students at the district level and not at the class level. These results might be biased due to the structure of the reform itself: it not only postponed the first tracking, but also

intentionally decreased the size of the outflow of students into the selective track. To deal with these two possible sources of bias and to check whether our results are robust, we further replicate this analysis using the longitudinal data from CLoSE, collected in the Czech Republic.

The advantage of the CLoSE data is that we are able to observe the outflow rate at the class level, and hence, to study the impact of the exact outflow of high-achieving peers on each individual student in the sample. This allows us to focus only on students who stayed in the same basic school during their primary and lower secondary education, the first nine grades. Further, compared to Slovakia, the outflow rate in the Czech Republic remained stable at around 10 % during the period examined. There is thus no fluctuation in the outflow rate that could have an additional impact on the results.

CLoSE also provides information about the key variables in the 5th and 9th grades, before early-tracking and at the end of lower-secondary education. Thanks to this, we are able to examine the changes in these key variables during lower secondary education and their relation with the real outflow of high-achieving peers from a class.[16]

Based on CLoSE data, Table 5 presents correlations between the outflow ratio of high-performing students in a class and the change in their peers' educational outcomes and attitudes between the 5th and 9th grades. The results are again estimated for the whole and restricted samples, omitting districts with more than 15% of pupils in schools offering only primary education. Both specifications are also estimated for girls and boys separately.

[16] The description of the model for this robustness check is presented in Appendix B. Table A2 in the Appendix shows the descriptive statistics of the CLoSE sample.

Table 5: The impact of an outflow of high-achieving students from class (CLoSE data for the Czech Republic)

	(1) All	(2) Girls	(3) Boys	(4) All	(5) Girls	(6) Boys
	Whole sample			Restricted sample		
Math score						
% outflow	-0.261	-0.229	-0.244	-0.612***	-0.793***	-0.420
	(0.204)	(0.253)	(0.288)	(0.226)	(0.291)	(0.394)
Like math						
% outflow	-0.142	0.019	-0.218	-0.090	0.110	-0.258
	(0.153)	(0.191)	(0.189)	(0.200)	(0.229)	(0.256)
Future plans						
% outflow	0.256**	0.345**	0.246	0.275*	0.431***	0.176
	(0.110)	(0.142)	(0.159)	(0.142)	(0.152)	(0.212)
Self-confidence in math						
% outflow	0.007	0.128	-0.038	-0.092	0.117	-0.304*
	(0.125)	(0.188)	(0.137)	(0.174)	(0.239)	(0.182)
N	2607	1294	1313	1469	735	734
R^2	0.492	0.492	0.519	0.478	0.483	0.510

Note: Standard errors robust to clustering at class level in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). All specifications control for individual characteristics (age, sex, parent's education, and books at home) and district specific effects.

Unfortunately, we are not able to examine the outflow effects using CLoSE data on the same student characteristics as in PISA data. The math score is the only variable estimated in both specifications. Estimating the impacts of the outflow of high-achieving students on math scores leads to the similar results as in previous specifications, however at a slightly lower magnitude for CLoSE. Using CLoSE data, the 10% outflow of high-achieving students from a class is significantly correlated with a decrease in their peers´ math scores of around 0.06 standard deviation between the 6th and 9th grades. This relation is significant only for the restricted sample and is mainly driven by girls. On the other hand, the outflow of students seems to have a negative relationship with self-confidence in math for boys, though the self-confidence of girls seems to be unaffected.

The positive effect of the outflow of high-achieving students on their peers' future plans to attend a university is a bit confusing. This result is again driven by girls, with no effect on boys. An outflow of 10% of the best students from a class results in an increase in the probability that girls will plan to go to a university of four percentage points. This unexpected positive effect may be explained by an increase in a student´s ordinal rank in the lower-secondary school after the high-achieving students leave. Recent literature[17] shows that holding a high school-ranking positively affects student´s future school and subject choices. Nevertheless, the change in their future plans during the lower-secondary education are likely to be affected by other unobserved characteristics that may bias our results.

5. Conclusion

Early tracking school systems have been a part of education policy discussions over the last decades. On the one hand, it intensifies inequality in education, by allowing the selection of students at very early ages. On the other hand, tracking can be positive in terms of creating more homogeneous class environments. This paper aims to contribute to the discussion about the efficacy of ability tracking and to look in more detail at the effects of early selection on pupils who do not transfer to selective academic schools but remain in their original primary school until the 9th grade.

We focus on the effects of the outflow of high-ability students after primary education on the long-term educational outcomes and behavior of their peers. Applying a triple difference methodology, we show that a 10% outflow of the best peers after primary education leads to a decline in math test scores of around 0.1 to 0.2 standard deviations

[17] See Murphy and Weinhardt (2020), Elsner and Isphording (2017), Delaney and Devereux (2021).

for students remaining in regular classes. In the case of undesirable student behavior, the effect is week and equal to around an 8% increase in late arrivals to school. Both results appear to be the same for girls and boys. The highest impact of the loss of the best peers is found in study time outside of class, which declines by around 2 hours per week in classes with 10% outflow. This effect is driven mainly by girls, who tend to decrease study time by as much as three hours per week. On the other hand, it seems that the loss of their best peers on boys is reflected in a decrease in their self-confidence.

However, these effects may not be caused solely by the outflow of their best peers, but also by changes in teacher's attitudes. Teachers work one year longer to support the best students into selective schools, but after they are gone, their motivation may decrease. However, evaluating possible teacher impacts is beyond the scope of this study and requires future investigation.

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APPENDIX A: TABLES

Table A1: The impact of the outflow of high-achieving students on reading and science scores of remaining students (Czech students used as a control group)

Reading scores	(1) all	(2) girls	(3) boys	(4) all	(5) girls	(6) boys
Whole sample						
Treatment	0.110	0.123	0.100	0.098	0.059	0.118
(SVK x 2012)	(0.076)	(0.087)	(0.083)	(0.142)	(0.164)	(0.163)
Treat x Outflow				-0.242	0.596	-0.740
				(1.174)	(1.403)	(1.392)
Restricted sample						
Treatment	0.174*	0.166	0.185*	0.211	0.190	0.221
(SVK x 2012)	(0.091)	(0.105)	(0.098)	(0.164)	(0.186)	(0.196)
Treat x Outflow				-0.573	-0.274	-0.672
				(1.170)	(1.413)	(1.381)
Science scores	(1) all	(2) girls	(3) boys	(4) all	(5) girls	(6) boys
Whole sample						
Treatment	-0.036	-0.086	0.007	-0.136	-0.290*	-0.020
(SVK x 2012)	(0.082)	(0.090)	(0.092)	(0.140)	(0.163)	(0.161)
Treat x Outflow				0.802	2.271*	-0.219
				(1.145)	(1.323)	(1.355)
Restricted sample						
Treatment	0.102	0.045	0.155	0.059	-0.021	0.120
(SVK x 2012)	(0.092)	(0.103)	(0.104)	(0.143)	(0.176)	(0.170)
Treat x Outflow				0.255	0.698	0.003
				(1.075)	(1.366)	(1.219)

Note: Standard errors are robust to clustering at the year and district level in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). All specifications control for individual characteristics (age, sex, parent's education, and books at home) and a school characteristic (the size of the municipality in which the school is located). *Read score* and *science score* are standardized PISA reading and science test scores. *Restricted sample* uses only districts with fewer than 15% of pupils in schools offering only primary education.

Table A2: Descriptive statistics of student and school background characteristics, students who stayed in the same regular school after the fifth grade

	5th grade	6th grade	9th grade
Standardized math test scores	-	-0.488	-0.059
		(0.699)	(0.863)
Like math (%)	60.2	56.9	34.2
Future plans – university (%)	48.2	-	54.0
Self-confidence in math (%)	68.3	69.2	49.1
Sex (% of boys)			51.6
Age in 2020 (years)			19.0
			(0.43)
Mother – university education (%)			20.0
Father – university education (%)			21.4
Books at home (%)			
0-10 books			6.3
11-25 books			15.6
26-100 books			36.0
101-200 books			20.9
201-500 books			13.6
more than 500 books			7.6
% of pupils in schools operating only primary level of education	14.6 %		
Outflow of students	8.2 %		
Number of observations	2,604	2,604	2,604

Source: CLoSE

Note: Standard deviations for selected characteristics are in parenthesis.

Appendix B: Robustness check model

Using the data from CLoSE in the Czech Republic, we examine the correlations between the outflow ratio of high-performing students and their peers' educational outcomes in the 9th grade. We estimate the following model:

$$Y_{ic}^{t} = \beta_0 + \beta_1 Y_{ic}^{t-1} + \beta_2 Outflow_{c}^{t-1} + \beta_3 X_{i}^{t'} + \delta_d + \varepsilon_{ic}$$

, where *Y* is the dependent variable (CLoSE score, students´ stated self-confidence, and future academic plans), of student *i* in class *c* and in grade *t*; *X* is a vector of student observed characteristics (age, gender, the number of books in the student's home, the highest achieved education of parents); and *Outflow* is the rate of outflow of high-achieving students into selective schools from class *c* and grade *t-1*. The two time periods refer to the 5th grade (period *t-1*), just prior to the first tracking, and to the 9th grade (period *t*), at the end of the lower-secondary track. The model further controls for district specific effects in δ_d. Coefficient β_2 is a key coefficient of our interest that accounts for the correlation between the changes in dependent variables during the lower-secondary track and the outflow rate of high-achieving peers at the end of primary education. We again examine the model separately for girls and boys in order to study possible gender specific associations. Student background characteristics and the outflow rate in the CLoSE sample are similar to data from PISA 2015 for the Czech Republic[18]. This indicates that the two samples are representative and comparable with each other.

[18] See Table A2 in Appendix with descriptive statistics of CLoSE.

Abstrakt

Školské systémy rané selekce, které rozdělují žáky podle dovedností, jsou považovány za spouštěcí mechanizmus prohlubující se nerovnosti ve vzdělávání. Zdá se však, že homogennější složení třídy vyplývající z této selekce dle dovedností zlepšuje efektivitu výuky a učení. Literatura o vlivech vrstevníků ukazuje protichůdná zjištění o těchto dvou protikladných efektech. Tento článek přispívá k diskusi o účinnosti rané selekce tím, že zkoumá dopady odlivu nadaných žáků po prvním stupni základní školy na dlouhodobé vzdělávací výsledky a chování jejich vrstevníků, kteří zůstávají v běžných třídách. Využitím školské reformy z roku 2009 na Slovensku, která posunula ranou selekci o jeden rok, ukazujeme, že odliv nadaných vrstevníků má slabý negativní dlouhodobý dopad na výsledky v matematice a na pozdní příchody do školy u těch, co zůstávají v běžných třídách, a trvalejší negativní vliv na čas, který věnují učení se mimo školy.

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