The Impact of High-Stakes School-Admission Exams on Study Effort and Achievements: Quasi-experimental Evidence from Slovakia*

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Abstract

High-stakes admission exams to selective schools create incentives for more intensive study effort possibly increasing study achievements of students. Exploiting exogenous change of a schooling system and using two waves of TIMSS survey data we find that high-stakes exams increase math test scores of 10 years old students by 0.2 standard deviations. This effect additionally accrues by around 0.1 standard deviations for students in the top decile, i.e. students who apply for selective schools with the highest probability. The most perceptive to incentives are test items referring to cognitive domain of reasoning requiring deeper understanding of math problems. Although the effects are similar for both genders, there are indications that girls exert higher study efforts in more competitive environment. This is in line with the widely accepted finding of developmental psychology that ten years old girls are more mature and more responsive to authorities than boys.

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1. Introduction

Literature in psychology, pedagogy and sociology provides rich evidence that students' motivations to learn are important co-determinants of educational outcomes (Vansteenkiste et al., 2004, Elliot, McGregor and Gable, 1999). The typical incentivising external factors that could motivate students to learn and improve their achievements are based on grading and evaluation schemes. Their impact on achievements depends on whether students perceive external factors as relevant for their future outcomes or as a mere task to be fulfilled (Ryan and Deci, 2000). An example of such external factors is high-stakes testing considered as an important instrument enhancing students' motivations and educational accountability (Jacob, 2005). Most empirical studies have focused on exit exams at the end of key schooling stages – as a one type of high-stakes testing – and most of them show an increase in study efforts and academic achievements[2].

However, the empirical evidence on the effect of exit exams combines students' motivation to learn and the incentives of teachers and school administrators (Jürges, Schneider and Büchel, 2005)[3]. Results from exit exams at school levels are frequently publicly known, closely watched, and create strong incentives on the side of teachers and principals. There is rich evidence that teachers tend to focus on teaching skills being tested at the expense of cultivating more complex skills which are not tested or cannot be tested easily[4]. Moreover, while exit exams usually test students at the end of lower and upper secondary stage of education, i.e. at the ages of 15 and 18, relatively little is known about the formation of motivation to learn at the age of 10, i.e. at the time when pupils transfer from

[2] See Jürges, Schneider, Senkbeil, and Carstensen (2012), Jürges, Schneider and Büchel (2005), Woessmann (2002), Bishop (1997).

[3] See Bishop (1997) and Bishop (1999) for the detailed description of incentives of students, parents, teachers, and school administrators induced by high-stakes testing.

[4] Jürges, Schneider, Senkbeil and Carstensen (2012) show positive effect of central exit exams only on exam-specific knowledge together with no effect on knowledge not included in tested fields. The similar result is shown by Jacob (2005). When the test results are relevant also for teachers and school administrators, it seems that teachers teach predominately the curriculum that is tested.

primary to lower secondary education. This age is characterised with high developmental changes and culminating gender differences in brain development (Lenroot et al., 2007).

In this study, we enrich existing literature by separating teachers' incentives from students' motivations to learn. In particular, we explore whether and to what extent high-stakes admission exams to selective schools affect students' study efforts and consequently their achievements. Our identification strategy exploits the quasi-experimental design of the 2009 school reform in Slovakia.

On the contrary to exit exams, the results from high-stakes admission exams to selective schools are not publicly known, are not perceived as an indicator of school quality, and hence, do not create motivations on the side of teachers. Moreover, in our empirical case there is anecdotal evidence that primary schools consider this early transition to selective schools as a threat to lose their best students. For these reasons, teachers and schools usually do not provide additional tutoring and do not teach to these admission exams. The effect of high-stakes admission exams we study can be thus attributed only to incentives of students and their parents.

High-stakes admission exams at early ages are the part of admission process to so-called Academic Schools that occurs in most central European countries such as Germany, Austria, the Czech Republic, Slovakia, and Hungary. This selection takes place at the end of primary education. There is anecdotal evidence that some parents and students take these exams very seriously. Using data from a unique longitudinal study following-up a cohort of students in the Czech Republic, Federičová and Münich (2014) examine the scale and scope of exam preparation. They find that among 20% of those who apply, nearly 85% devote some time to their preparation every week, and among those, even more than half of them prepare for admissions almost every day. In the same time, only small group of students has an opportunity to attend a preparatory course at their school. Moreover, they show the vast majority (90%) apply on the basis of their own and their parents' interests and only half of the teachers are reconciled with their school transition intention.

Our estimates imply that high-stakes exams increase math test scores of 10 years old students by 0.2 standard deviations. Using the quantile regression, this effect additionally accrues by 0.1 standard deviations for students in the top decile of the math test score distribution, i.e. students who apply for selective schools with the highest probability. Besides the impact on the overall math score, we also investigate the impact on test-scores covering different cognitive domains: knowing, applying, and reasoning. We find that equally to the basic skills – measured by knowing part – students improve also their skills in more complex contents measured by reasoning parts. Furthermore, we find some differences in behaviour between girls and boys. Although the main effect of admission exams is about the same, girls seem to put higher study efforts into succeeding in admission exam in districts with more intense selection process.

We use a quasi-experimental feature of the 2009 school reform in Slovakia to identify the effect of high-stakes admission exams on students' achievements. The main element of the reform was a shift in student's transition to selective lower-secondary Academic Schools from the end of the 4th to the end of the 5th grade. To provide empirical evidence we use the data from an international survey TIMSS in 2007 and 2011 that test students at the end of the 4th grade. In 2007 – before the 2009 school reform – TIMSS tested students already prepared for admission exams, whereas in 2011 – after the reform – TIMSS tested students that would apply for Academic Schools one year later. Since admission exams to Academic Schools typically include tests in mathematics and national language, the inter-temporal change in the TIMSS math scores corresponding to the change in study achievements can be causally related to changes in incentives caused by high-stakes admission exams. We use the data from Slovakia and the Czech Republic – successors of the former Czechoslovak federation – and employ the difference-in-differences methodology to identify the effect of these admission exams.

Our paper is structured as follows. Section 2 reviews the literature on the role of motivations and the existing empirical findings on the effect of high-stakes testing on students' achievements. Section 3 describes the process of academic selection in the Czech Republic and Slovakia. Section 4 and 5 discuss the data and the identification strategy. Section 6 presents the results and Section 7 concludes.

2. Literature Review

In the field of educational psychology, motivation plays an important role in exerting efforts, enhancing educational outcomes (Crumpton and Gregory, 2011, Hidi and Harackiewicz, 2000), and in the long-run, it can also affect labor market outcomes of individuals (Dunifon and Duncan, 1998). This is reflected in the commonly accepted definition of motivation that defines it as a force that moves one to act (Ryan and Deci, 2000). Classical motivational theory distinguishes two types of motivation, intrinsic and extrinsic. Intrinsic motivation is linked to individual interests and has positive impact on students' achievements. Extrinsic motivation accrues from external factors such as rewards, deadlines, competition, or performance evaluations and can foster or undermine the impact of intrinsic motivations (Crumpton and Gregory, 2011).

Keeping the dichotomy of intrinsic and extrinsic motivation in mind, Ryan and Deci (2000) formulated new self-determination theory (SDT). SDT defines several types of extrinsic motivation differing by the level of self-determination. In other words, the distinguishing feature is the extent one perceives external factors as important for their own sake. Some external factors motivate individuals only to obtain rewards or to avoid punishments. These incentives disappear with the disappearance of the source of motivation and hence do not motivate individuals to acquire new skills or personal goal formation. On the other side, there are external factors that are personalized and finally identified as individual to that person. Although this extrinsic motivation is not driven by some inherent interest – as it is in the case of intrinsic motivation – it can enhance intrinsic motivation when students perceive the external factors as important for their present or future outcomes.

High-stakes exams, such as those related to school admissions or school grade / stage, represent specific external factors of motivation. Although they are usually not intended to foster motivation per se, they do so, because they are widely perceived as prestigious and important for future career. Therefore, they can facilitate intrinsic motivation, and hence, lead to higher achievements. Several empirical studies found positive effect of such high-stakes exams. Jacob (2005) shows that new policy introducing high-stakes testing in several grades – as a requirement for transition to higher grades – in Chicago schooling district increased average math and reading test scores by 0.2 to 0.3 standard deviations. Central exit exams in cross country comparison studied by Woessmann (2002) yield even higher effects on math literacy with a magnitude around 0.4 standard deviations. By using the variation in schooling systems across German states, Jürges, Schneider, Senkbeil and Carstensen (2012) find that students in states with central exit exams outperform students in states without such exams by 0.26 standard deviations in tested subjects. Though, they find no effect on literacy not being tested by central exit exams. They interpret their finding as the accountability feature of high-stakes exams contributing to monitoring of schools and teachers, either by parents or school administrators. Contrary to this, high-stakes admission exams to selective schools motivate primarily students and their parents and not schools and teachers. This is because schools have no interest to lose their best students. Thus, the transition to selective schools depends primarily on student's and their parents' aspirations.

Intergenerational transmission literature[5] provides rich evidence that parents play important role in interaction with extrinsic motivations. In our case, it is the parental push to apply for selective schools and prepare for admissions. There are good reasons to expect different impact on genders. At the time of early school selection – usually at the age of ten or eleven – boys are less mature and are less responsive to parental authority than girls (Wilder and Powell, 1989). As a consequence, boys are more likely underestimating the importance of schooling for their future educational and labor market outcomes. On the other hand, high-stakes admissions give rise to psychical stress that probably works against girls´ test achievements as documented by Gneezy and Rutshini (2004) and Jurajda and Münich (2011).

3. School Selection in the Czech Republic and Slovakia

Our identification strategy relies on a policy intervention in Slovakia. In addition to Slovak data, we use data from the Czech Republic to control for common trends. Slovakia and the Czech Republic are successors of the former Czechoslovak Federation dissolved in 1993. Although since then both countries have developed separately, they have remained extraordinary similar in terms of demographic structures and institutions, including their school system (Table 1). Both systems allow for early tracking of students into selective schools. In particular, at the end of the 5th grade, small proportion of students has an option to move from so called *Basic School* (lasting 8 - 9 grades) into so called *Academic School*. Studies at Academic School last eight years and cover both the lower- and upper-secondary level. In both countries, school types similar to Academic Schools had tradition before the Second World War but were closed by the communist regime in early 1950s. After the Velvet revolution in 1989, Academic Schools were re-established in both countries. The only

[5] For impact of the family background on children academic outcomes see Cunha and Heckman (2007), Feinstein (2003), Anger and Heineck (2010). For the impact of parents attitudes on the development of children´s attitudes and on the creation of their goals and motives see Grolnick and Ryan (1989), Friedel, Cortina, Turner and Midgley (2007).

difference between these two countries was the grade of enrolment. In the Czech Republic, Academic Schools had enrolled students after their 5th grade whereas in Slovakia it was after the 4th grade. The 2009 school reform in Slovakia brought forward shift in the enrolment grade by one year. Moreover, as a part of the reform, Slovaks have successively reduced the proportion of students enrolled in Academic Schools from 9% in 2009 to 5%.

Table 1: Characteristics of school system in the Czech Republic and Slovakia

Characteristics of school system	Czech Republic	Slovakia
School entry age[6]	6 - 7	6 - 7
-number of years of compulsory education	9	10
-number of grades in primary and lower secondary education	9 (8 before 1998)	9 (8 before 1998)
The grade of the first academic selection	6	6 (5 before 2009)
The average number of pupils in class (2010)		
-in primary education	19	18
-in lower secondary education	19	20
The teacher-pupil ratio (2010)		
-in primary education	1:17	1:14
-in lower secondary education	1:11	1:11
Owner structure of primary and lower secondary education (2011)		
-% of students in private schools	0,8%	0,9%
-% of students in church schools	0,7%	5,1%
Owner structure of upper secondary edu. (2011)		
-% of students in private schools	12,9%	9,5%
-% of students in church schools	1,8%	2,4%
Government expenditure on education (2010)	4,7% of GDP	4,6% of GDP

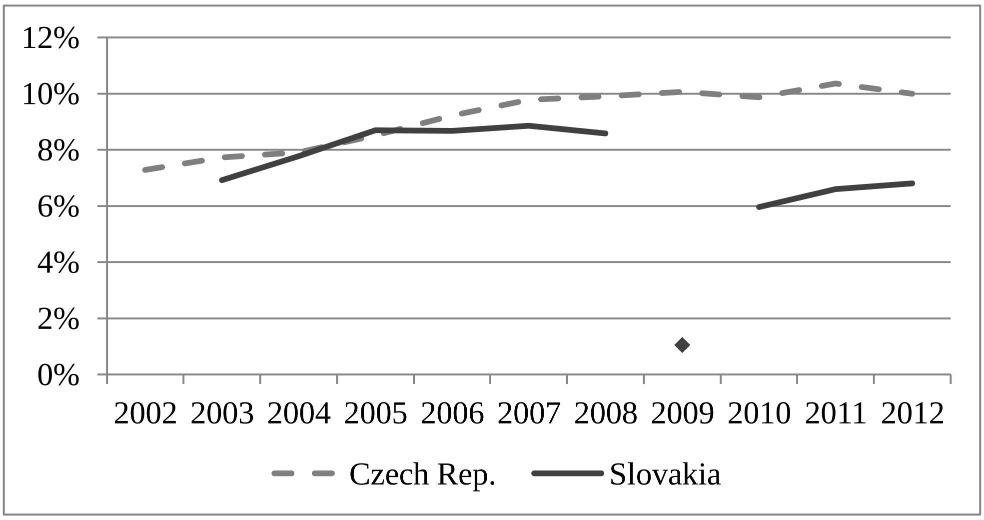
Although the curriculum taught at Academic Schools does not differ from the curriculum taught in corresponding grades of mainstream Basic Schools, it is taught there in greater depth and intensity and higher study requirements are imposed. Compared to Basic

[6] Pupils can enrol into Basic School if they reach six years of age in September 1 of given school year. Children can enrol at the age of 7 if recommended by pedagogy advisor or upon parental request.

Schools, Academic Schools have been perceived as more prestigious, of better quality, securing better peers and as a result they considerably increase students' chances in admission to high quality universities. Since the number of slots is kept fixed, Academic Schools have been facing substantial excess demand since their re-establishment in 1990s. The excess demand generates extrinsic study motivation to pass demanding admission exams.

Since 1989, in both countries, the share of students in Academic Schools has grown gradually (Figure 1). The positive trend during last decade was autonomous due to demographical decline vis-à-vis fixed number of slots in Academic Schools. The only intentional change in the selectivity rate was brought by the 2009 school reform in Slovakia. Regarding the gender composition, girls only slightly outweigh boys in Academic Schools.

Figure 1: The enrolment in the first grade of Academic Schools (lower secondary) as a share of an age cohort



Source: National statistical offices.
Note: The sudden drop in the time series of Slovakia was caused by the 2009 school reform.

In the school year 2011/2012, there were 275 and 147 Academic Schools in the Czech Republic and Slovakia, respectively. Each Academic School uses its own admission criteria which are, in most cases, based on written tests. Tests in mathematics and national language are most common. Some schools also use general study aptitude tests or adopt additional criteria like student's grade performance at Basic School or achievements in mathematical and other Olympiads. In the Czech Republic in 2011, almost half of Academic Schools use tests designed and sold by private agency Scio. Admission exams are administered at the end of April and at the beginning of June in the Czech Republic and Slovakia, respectively. Before the 2009 reform in Slovakia, the TIMSS testing coincided with admission exams to Academic Schools. After the reform, the TIMSS testing preceded admissions by about one year.

It should be taken into account that Basic Schools consider transitions of their students to selective schools as detrimental because they lose the best ones. Hence, the majority of Basic Schools do not offer additional tutoring to applying students. The effect of high-stakes admission exams to selective schools can be then attributed only to incentives and additional efforts of students and their parents.

4. Data

TIMSS is an international[7] survey testing 4th graders in mathematics and science skills in four year cycles[8]. We employ two successive rounds of TIMSS: the 2007 round, i.e. before the school reform in Slovakia, and 2011 round, i.e. after the reform. We also use data for the Czech Republic serving us as a control group. In our analysis, we exclude pupils from the two largest cities in Slovakia, i.e. Bratislava and Košice, and in the Czech Republic, i.e. Prague and Brno, because they represent very specific schooling regions with higher proportion of students commuting from neighbouring regions. Moreover, we drop observations from three

[7] The TIMSS assessment data are comparable across all participating countries, since all students are in TIMSS tested by the same set of test items. Moreover, various procedures during the preparation of test items ensure compatibility of the test results across all countries (Mullis, Martin and Foy, 2008).

[8] The assessment data from the first cycle of TIMSS in 1995 were scaled by setting the mean test scores from all participating countries equal to 500 and the standard deviation to 100 (Olson, Martin and Mullis, 2008). In each successive TIMSS cycle, the assessment data were placed on the scale from previous cycle to provide accurate measures for trends across all cycles of TIMSS.

Slovak and three Czech districts that exhibit unusually high excess demand for Academic Schools.

In our investigation, we deal not only with the overall math scores but also with test scores mapping to three cognitive domains (Mullis, Martin and Foy, 2008): knowing, applying, and reasoning. 40% of TIMSS math test items are aimed at the student´s knowledge base (knowing domain), 40% at the ability to apply math knowledge (applying domain) and 20% at deeper understanding of math problems (reasoning domain). Individual math test items were constructed in a way to enable the comparison between these cognitive achievement scales (Mullis, Martin and Foy, 2008).

Figure 5 depicts kernel densities of TIMSS math test scores[9] in both countries and in years and Table 2 reviews corresponding basic distributional characteristics. In 2007, in terms of average scores, the Czech Republic lagged behind Slovakia, but in the following years its average test scores grew five times faster than in Slovakia so that average scores in both countries were very similar in 2011. This pattern is in line with our key hypothesis that additional study effort due to preparation for admissions (present in Slovakia in 2007 but not in 2011) increases study achievements. Table 3 describes the same for individual cognitive domains. Math achievements in all three cognitive domains have increased in both countries but noticeably more in the Czech Republic. The highest growth appeared in cognitive domains of knowing and reasoning in the Czech Republic. This could be due to the adverse impact of the Slovak reform we explore in the next section.

To account for possible dependence of the strength of extrinsic motivations on student's demographic and socio-economic family background, we control for individual characteristics. In particular, following common practice, we use the number of books at

[9] TIMSS provide five plausible values that represent student math test scores (Foy, Galia and Li, 2008). To compute descriptive statistics of math test scores and regression coefficients and their standard errors, we apply Rubin's (1987) methodology for multiple imputations.

home as a proxy for socio-economic family background[10]. TIMSS reports the number of books on a discrete scale. The distributions of book possession are similar in both countries and exhibit similar, relatively small changes between the two years (Table 4).

4.1 Excess Demand

We explore whether the presence of high-stakes admission exams gives raise to extrinsic motivations fostering study efforts of students and increasing their study achievements measured here by TIMSS math test scores. If selective admission to Academic Schools creates additional study incentives, greater incentives and impact might be observed in districts experiencing higher relative excess demand (measured as a ratio of applications to admitted students minus 1) and negligible incentives in districts with zero excess demand. Therefore, we collected district level data from school registers and merge them to TIMSS data. Figure 3 and Figure 4 depict the levels and changes in demand, supply and relative excess demand for Academic Schools between years 2007 and 2011 at the district level. The systematic drop in supply in almost all Slovak districts in 2011 was due to the 2009 school reform. Some Academic Schools did not re-open classes or reduced class sizes11 resulting on overall drop in supply by 28%. However, the demand for Academic Schools in Slovakia dropped too (by 24%), so that the relative excess demand stayed about the same. The drop in demand has been caused by three simultaneous factors: (i) demographic decline in corresponding age cohorts, (ii) government's and elementary schools' incentives12 to reduce academic selection, (iii) drop in admission chances that might discourage some students to apply. In the Czech Republic, while supply between the two TIMSS rounds was relatively

[10] See e.g. Brunello and Checchi (2006) that show the number of books at home and the highest completed education of parents give similar effects on study achievements.

[11] In Nitra region, the half of the first classes in academic schools was closed. As the demand for academic schools decreased only by 20%, the excess demand increased sharply in 2011 in Nitra. In Prešov, it was other way round. Although the supply dropped to half, the excess demand did not change significantly as the demand for Academic Schools also decreased by 40%.

[12] The early-tracking of students to Academic Schools is considered in Basic Schools as a threat to lose the best students. Hence, school administrators and teachers do not support additional preparation for admission exams and sometimes even discouraged students and parents to apply.

stable, demand has increased by 20%. This led to higher relative excess demand (around 30%) driven primarily by demand in districts which have faced high demand and high relative excess demand already in 2007.

5. Methodology

Our identification strategy employs the quasi-experimental feature of the 2009 school reform in Slovakia, i.e. an exogenous forward shift of the grade when selection to selective Academic Schools takes place. Before the reform, the selection occurs at the end of the 4th grade based on admission exams organised in early June. In 2007, the selection coincided with the TIMSS testing organised in May, again for the 4th graders. In 2011, after the reform, the TIMSS testing preceded admission exams by about one year. Before the reform the TIMSS tested students who had already finished preparation for admission exams while after the reform, the TIMSS tested students before they start preparing for admission exams. Our key hypothesis is that this forward shift of the grade of selection lowered study incentives of students in the 4th grade leading to lower study achievements in TIMSS 2011 in Slovakia. To control for possible trends in test scores between 2007 and 2011 unrelated to the 2009 reform, we use Czech Republic pupils as a control group. Note that there was no such a reform in the Czech Republic and the selection into Academic Schools has always taken place at the end of the 5th grade. Such data allow us to apply difference-in-differences methodology (DID) controlling for time- and district-specific effects (Wooldridge, 2002).

To examine the impact of admission exams on achievements via higher study effort, we estimate the following model:

$$S_{it}^{d} = \alpha + \beta_1 DD^{SVK} * DY^{2007} + \gamma_1 DY^{2007} + \gamma_2 DD^{d} + \gamma_3 X_{it}^{d} + \epsilon_{it}^{d} \qquad (1)$$

where *S* is the math score[13] of student *i* in year *t* and in district *d*, DD^{SVK} is a dummy equal to 1 for Slovak districts and 0 for districts in the Czech Republic and DY^{2007} is a time dummy equal to 1 for the year 2007, i.e. before the 2009 reform, and 0 for the year 2011. Thus, year 2011 and the Czech Republic represents the base captured by the intercept α. Furthermore, we control for time (DY^{2007}) and district (DD^{d}) specific effects. We also control for observed individual and school characteristics in vector X, such as student's age, number of books at home, and municipality size of school location. The key coefficient of our interest is β_1 capturing the effect of high-stakes admission exams (treatment) on achievements of Slovak students in 2007, i.e. before the reform. To allow for different impact on boys and girls, we estimate Eq. (1) separately by genders.

The presence of high-stakes admission exams is not the only factor at the level of school system that can affect students' study efforts and their achievements. The degree of excess demand can foster incentives and increase performance in order to secure the admission. This establishes variation in competitiveness across districts and in time. Given that the excess demand is correlated with the interaction term, the estimate of interaction coefficient in the previous specification of Eq. (1) may be biased due to omitted variable. To get unbiased estimates we consider augmented specification of Eq. (1) controlling for relative excess demand:

$$S_{it}^{d} = \alpha + DD^{SVK} * DY^{2007}(\beta_1 + \beta_2 ED) + \gamma_1 DY^{2007} + \gamma_2 DD^{d} + \gamma_3 X_{it}^{d} + \gamma_4 ED + \epsilon_{it}^{d} \qquad (2)$$

where *ED* is relative excess demand[14] for Academic Schools in district *d* and time *t*. Note that the degree of selectiveness should matter only in Slovakia before the reform, and hence, the coefficient γ_4 should be insignificant. The coefficient on the interaction term between

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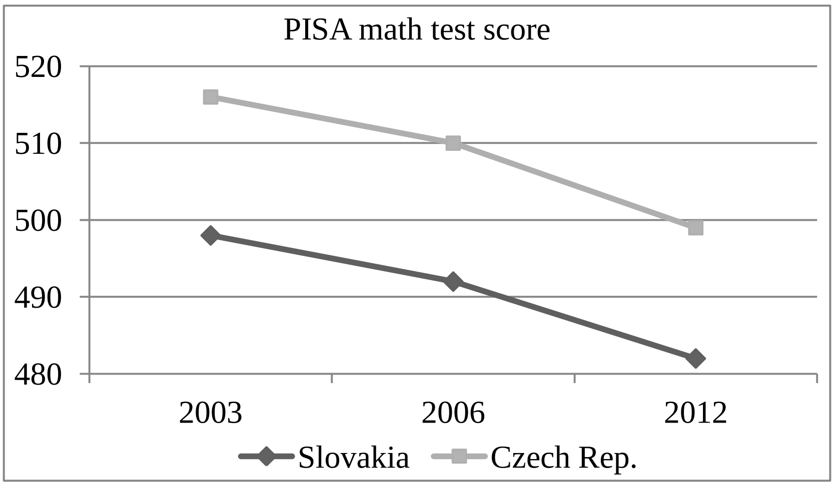
[13] The mean of the math test score distribution is normalized to 0 and the standard deviation to 1.

[14] Excess demand is measured as a ratio of applications to admitted students minus 1, i.e. zero excess demand represent districts with the same number of applications as admissions.

treatment and the excess demand (β_2) captures the change in achievement due to more intensive study efforts initiated by more competitive environment.

Our key identifying assumption is that in the absence of treatment our coefficient of interest β_1 would be equal to zero. Specifically, it means that on average and conditional on our covariates the TIMSS test scores in the Czech Republic and Slovakia would have followed the same trends if the Slovak reform did not occur. As we point in previous Section 3, after the division of Czechoslovakia the school system of the two countries remained very similar. Moreover, using the international survey PISA[15] that test 15-years old students we show that the Czech Republic and Slovakia follow the parallel time trends in math test scores (Figure 2).

Figure 2: Time trends in math test scores (PISA) in the Czech Republic and Slovakia



Source: PISA 2003, 2006 and 2012.

It should be noted that only 20% and 10% of students in the Czech and Slovak Republic, respectively, apply for Academic Schools. Therefore, one can argue that high-stakes admission exams have greater impact on the study effort and achievements of applicants while the impact on other students via, for example, peer-effects, is much lower. Unfortunately, TIMSS data do not contain information on whether individual students apply

[15] We should show that TIMSS test scores in the two countries evolve with parallel trends after the 2009 reform in Slovakia. However, the TIMSS test scores after 2011 are not available yet.

or not. We use two alternative approaches taking into account that probability of applying is higher at the upper tail of the initial skills distributions.

First, we estimate model (2) by a quantile regression[16]. The quantile regression model estimates how the mean response to treatment translates to different parts of the conditional distribution of TIMSS test scores. Thus, in contrast to linear regression model estimating conditional mean function, the quantile regression model estimates the conditional quantile function (Hao and Naiman, 2007).

Second, we estimate the percentile distance of each student from the admission threshold and enter it as additional covariate to models (1) and (2). We assess the distance in the following way. We estimate the probability of a student applying to Academic School using data from an ad-hoc follow-up survey of the Czech TIMSS 2011 cohort at the end of the 5th grade (one year after TIMSS testing) containing information on whether student applied to an Academic School[17]. We use estimated parameters of a probit model admitted / not admitted to predict corresponding application probabilities for Slovak students. By ranking students by predicted probabilities within each district and taking into account district specific number of slots at Academic School we compute absolute percentile distance of each student from the admission threshold in both directions[18].

Finally, we also estimate model (2) replacing overall math score on the left-hand side by tests scores capturing individual cognitive domains of knowing, analysing, and reasoning.

[16] For detailed description of quantile regression see Koenker (2005).
[17] Czech longitudinal project Close run a follow-up survey of the TIMSS 2011 students' cohort one year later and asked detailed questions concerning the preparation for Academic School admissions and results of admissions. Close data allow us to estimate a Probit model of the probability of being admitted to Academic School for the Czech sample of TIMSS 2011 students.
[18] This threshold is specified for each district by the proportion of students in Academic Schools in its first year to the number of students in the respective cohort.

6. Results

Table 5 presents estimated coefficients and their standard errors for different specifications of the difference-in-differences models (1) and (2) for girls and boys separately. The *treatment* variable is the dummy for Slovakia in 2007. For easier interpretation of estimated coefficient, we standardized test scores so that in 2007 they have zero mean and standard deviation equal to one[19]. In the base-line model presented in Column (1), the average treatment effect is significant and equal to 0.13 and 0.18 standard deviations for girls and boys, respectively. Controlling for individual and school characteristics in Column (2), the treatment increases to about 0.22 standard deviations with negligible gender difference.

We additionally control for the intensity of competition in admission by relative excess demand *ED* in Column (3). Significant positive coefficient on the linear term of the excess demand in case of girls indicates stronger impact on attainment in districts with higher competition. But, higher competition shows no impact on study efforts of boys. Regardless of the excess demand, average treatment effect of boys is equal to 0.22 standard deviations. For girls, average treatment effect rises from 0.13 standard deviations in districts with zero excess demand to 0.37 standard deviations in districts with relative excess demand equal to 1, i.e. with two applications per one slot. Hence, in districts with more competitive admissions girls seems to devote higher efforts resulting in higher achievements. This is translated to the gender difference in average treatment effect being about 0.15 standard deviations.

Quantile regression estimates for 10th, 25th, 50th, 75th, and 90th quantiles are reported in Table 6. The estimated impact of the treatment at the 90th quantile (i.e. the upper end of the test score distribution) is higher than the treatment in lower quantiles and the base-line model estimates in Table 5. Moreover, in case of boys, the treatment effect increases steadily from zero in the lowest decile to significant and positive effects in higher quartiles. The treatment

[19] Standardized score S is computed from original TIMSS scores T as $S = (T - T_{2007})/\sigma_{2007}$, where T_{2007} is mean score and σ_{2007} is standard error in 2007 (both countries).

boosts the median test scores of boys by 0.29 standard deviations and rises to 0.32 standard deviations for students on the 75th quartile. On the other hand, estimated treatment effect for girls is significantly positive only for the median test scores and the top decile equal to 0.14 and 0.17 standard deviations, respectively.

The treatment effect notably increases with the intensity of the selection process. This applies especially to the girls whose estimated treatment effect is significantly positive in all quartiles between 0.21 to 0.28 standard deviations. Among girls at the top decile, a unit change[20] in relative excess demand raises the achievement by 0.42 standard deviations compared to the 0.25 standard deviations in conditional means. For boys, a unit change in relative excess demand has a significant impact on the treatment effect only at the top decile and is equal to 0.16 standard deviations. Otherwise, this effect is insignificant throughout the rest of TIMSS math test score distribution. Thus, in the districts with zero excess demand, the presence of admission exams affects more the study efforts of boys than girls (by 0.07 standard deviations) whereas in the highly competitive districts, i.e. with excess demand equal to 1, the treatment effect on achievements is higher for girls by around 0.2 standard deviations.

Table 8 presents estimates of models (1) and (2) using the estimated absolute distances of students from district specific admission thresholds. The estimated treatment effect is equal to 0.19 and 0.15 standard deviations at the admission threshold for girls and boys, respectively, and is significantly declining with the increasing distance from the threshold.

The augmented specification is presented in the 2nd column. Controlling for the excess demand, the treatment effect becomes insignificant for both girls and boys. It means that there is zero treatment effect at the admission threshold in districts with no selectivity. However, a unit change in relative excess demand significantly raises the treatment effect by 0.6 and 0.4

[20] Note that a unit change in relative excess demand corresponds to a substantial growth from a balanced demand-supply to demand being twice of supplied slots.

standard deviations for girls and boys respectively. This effect is further declining with the distance from the admission threshold. A percentile change in distance decreases the treatment effect by 0.006 and 0.003 standard deviations for girls and boys, respectively.

Table 9 presents estimates of Eq. (2) and its versions for individual cognitive domains, i.e. knowing, applying and reasoning domains. For girls, we find the highest treatment effect for reasoning test items equal to 0.25 standard deviations, whereas for knowing test items it is only 0.15 standard deviations. Boys improve in knowing and reasoning test items equally by around 0.2 standard deviations. The treatment effect is insignificant for analysing test items for both girls and boys. However, girls increase significantly their achievements in applying test items with the more competitive admissions. The effect of excess demand for different test items is significant only for girls. A unit increase in relative excess demand raises achievements in knowing test items by 0.29 standard deviations, with slightly lower effect for reasoning test items (0.21).

7. Summary and Conclusion

We address important policy questions concerning students' motivation to study and learn. Educational psychology studies consider the role of external factors such as rewards, deadlines, competition or evaluation. Plethora of studies in this area shows that such incentives can increase students' study performance but can also undermine it. Our analysis focuses on particular, but very common and rarely investigated, study incentives born by high-stakes admission exams and their consecutive impacts on student's achievements. High-stakes admission exams at early ages differ from other high-stakes testing like exit exams in that they affect out-of-school learning effort while not affecting in-school teaching intensity. If some students and their parents perceive admission exams to selective schools as contributing positively to their future study and labor market outcomes, such exams create additional study incentives based on personal interest.

Our empirical findings indicate that the presence of high-stakes admission exams to Academic Schools at the end of primary education motivate some students to intensive study efforts leading to higher achievements. Our identification strategy utilising exogenous quasi experimental policy intervention estimates treatment at the range of 20% of standard deviation. The size of the treatment effect is very similar to the findings in existing empirical studies, although they report together students' efforts and teachers' incentives. The effect is of the same nature for both genders but girls seem to be more sensitive to the degree of competition and peer's pressures. Although girls in average lag behind boys in mathematics, they are not deterred from admission exams and put higher efforts to secure their admission, especially, when they face pressure from more intense selection process. We find that in districts with the most competitive admissions, i.e. with two applicants per one slot, girls increase their achievements by 0.37 standard deviations when they face admission exams in the near future. This effect is even higher on the top decile equal to roughly 0.6 and 0.4 standard deviations for girls and boys, respectively. Possible gender differences in motivation and its effect on academic performance can contribute to the gender inequality in educational outcomes, such as participation in academic education or test achievements. However, further research is needed to better understand the origin and consequences of gender differences in creation of motivations to learn.

Our estimates identify notably greater impact in the domains of reasoning and knowing. Hence, approximately equally students improve both their basic and more complex math skills requiring a study strategy of deep processing (Elliot, McGregor and Gable, 1999). This support the results of positive effect of high-stake admission exams as the deep processing is usually connected with intrinsic motivations enhancing study achievements.

Our findings should be used cautiously when arguing for early school selection. This is because early selection involves many other effects which, from a normative point of view, are much less desirable. These include the important role of family wealth, time devoted and personal pressure on the side of parents and perseverance, ambition, and rigour on the side of students. This means that selective schooling systems open space to factors whose role should be diminished by the primary schooling system. It relates to the current debate in the UK about Grammar Schools enrolling students well prepared to pass admission exam but not having sufficient study skills to make follow-up study progress.

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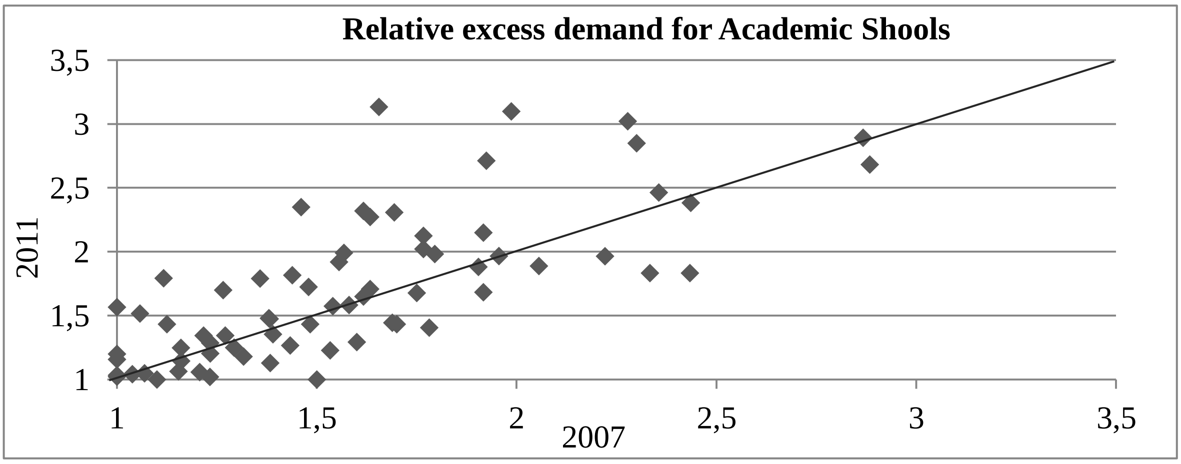
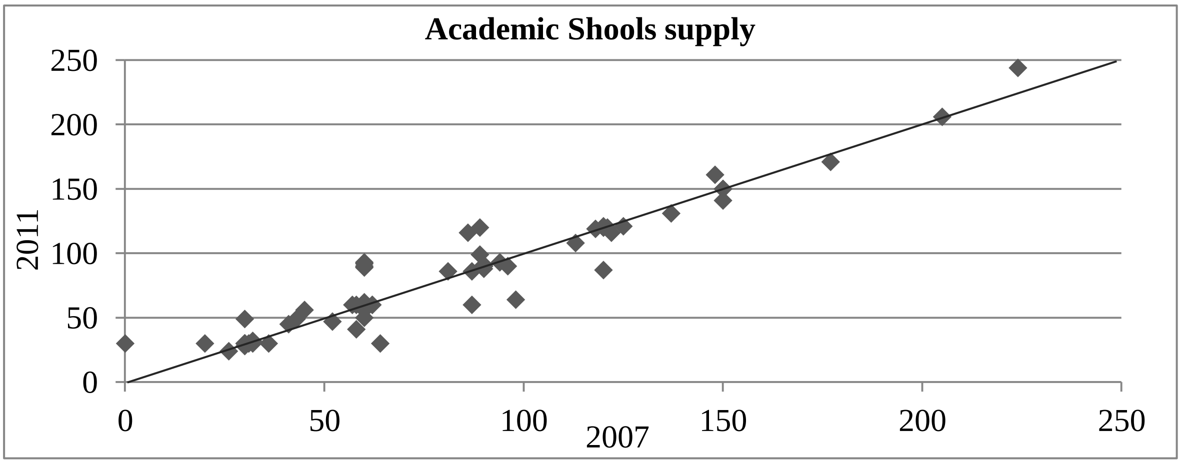
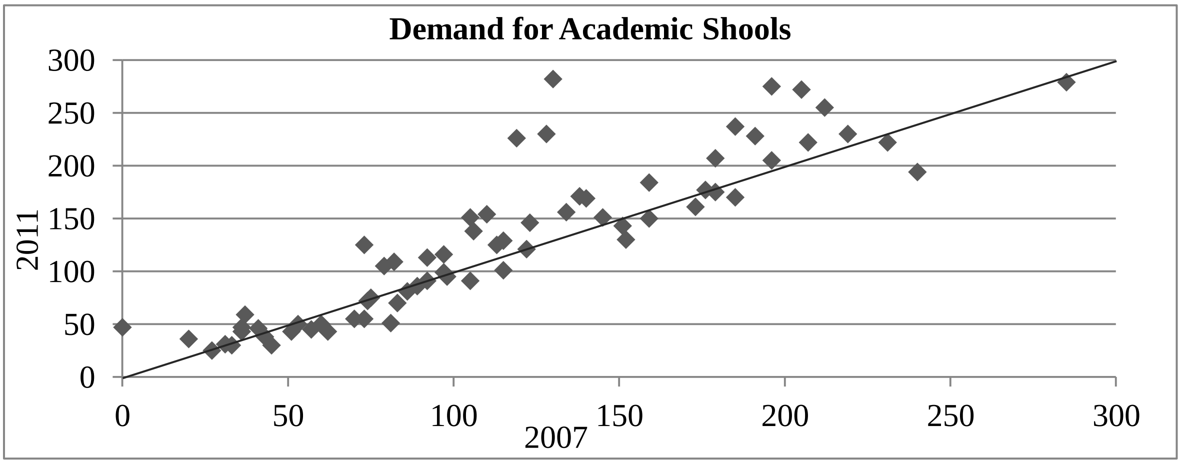
Figure 3: Academic School´s demand, supply and relative excess demand in years 2007 and 2011, by Czech districts

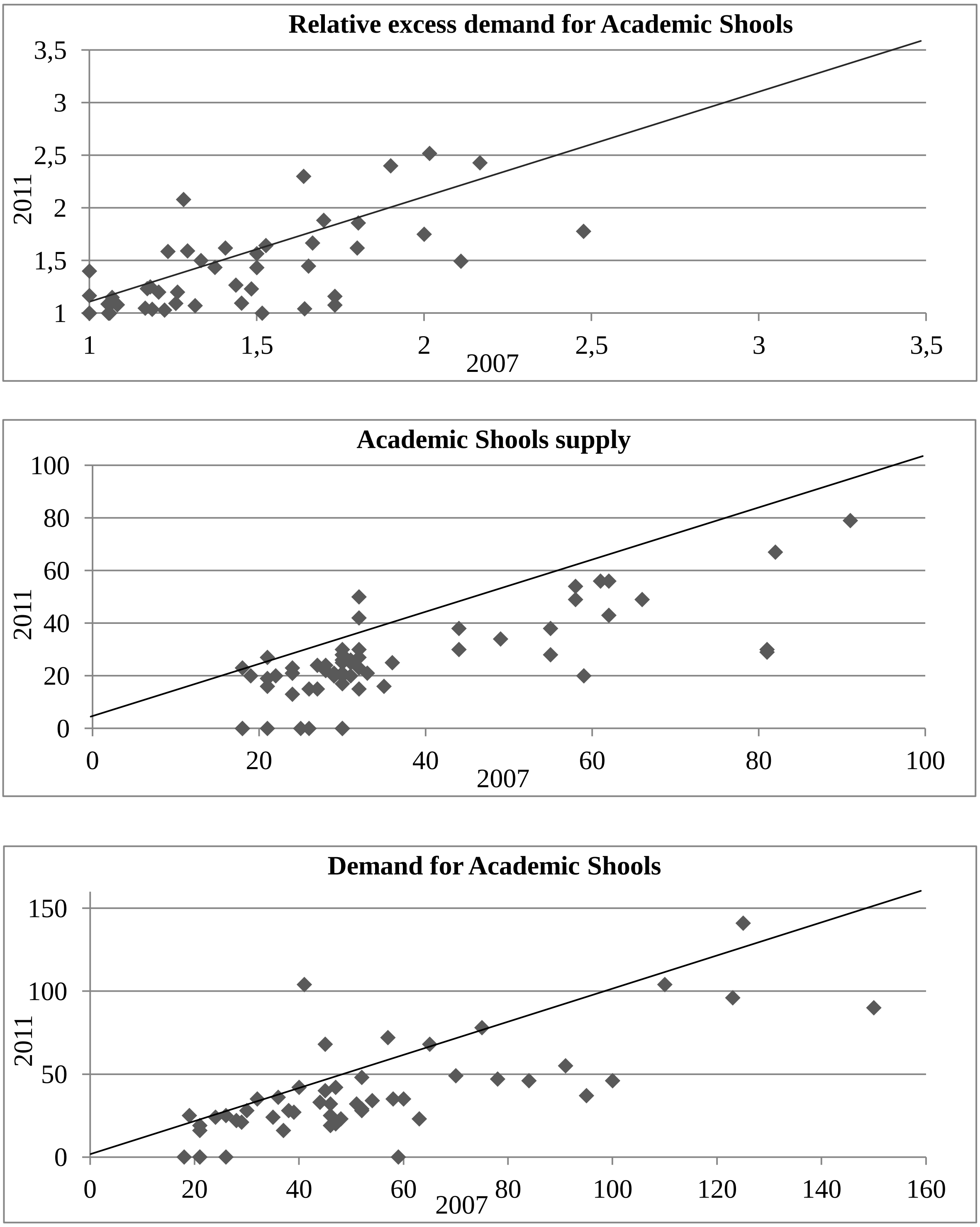






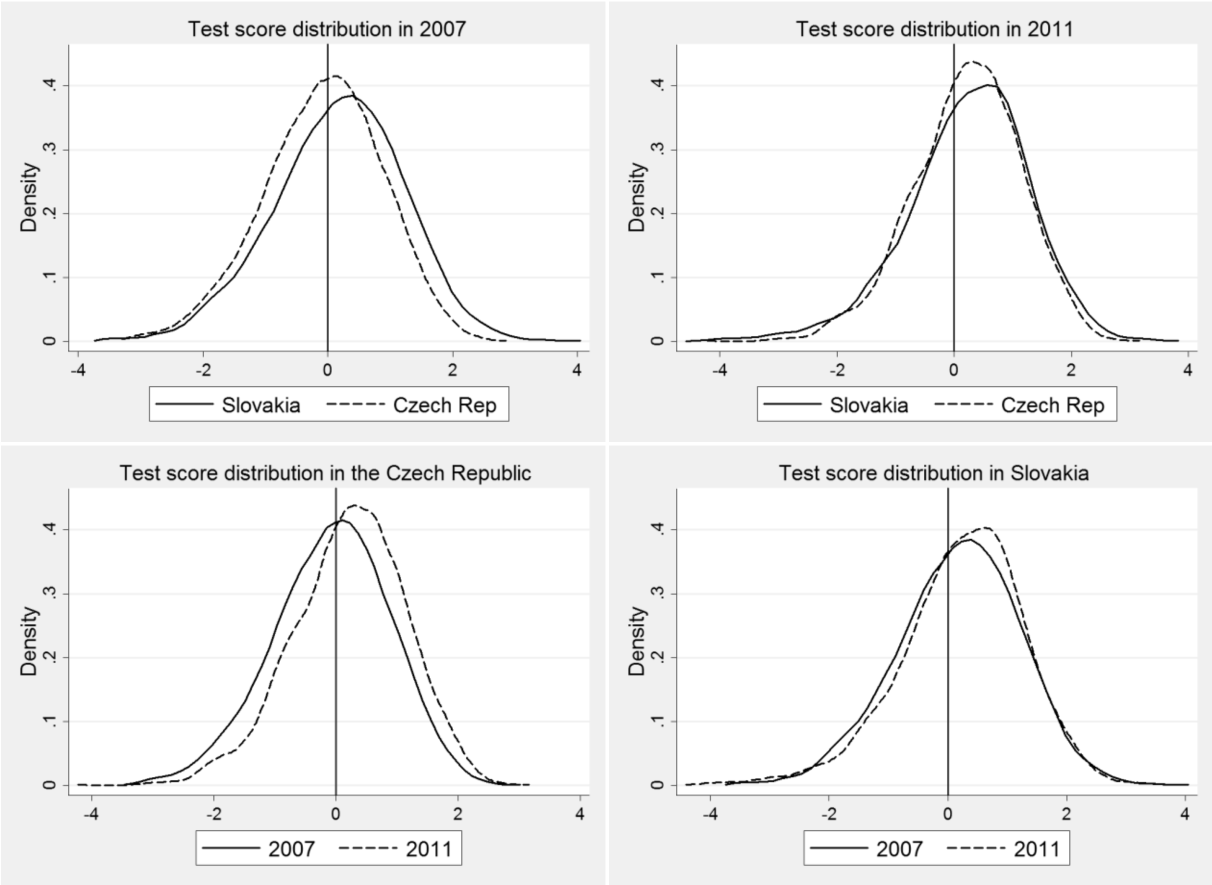
Source: MŠMT

Figure 4: Academic School´s demand, supply and relative excess demand in years 2007 and 2011, by Slovak districts



Source: ÚIPŠ

Figure 5: Math test score distributions in years 2007 and 2011



Source: TIMSS 2007 and 2011.

Table 2: Mean test scores in math in Slovakia and the Czech Republic in 2007 and 2011, by gender

Country	Year	Total	Girls	Boys	Share of girls	N
Slovakia	2007	501.6	498.6	504.4	0.49	3,519
		[78.3]	[75.8]	[80.7]		
	2011	506.1	501.6	510.5	0.50	3,852
		[78.3]	[79.4]	[77.1]		
	Δ 2011-2007	4.5	3.0	6.1		
		(6.6)	(6.6)	(7.2)		
Czech Republic	2007	482.8	481.2	484.3	0.48	3,517
		[72.4]	[69.1]	[75.3]		
	2011	505.9	499.6	511.9	0.49	3,191
		[68.7]	[67.4]	[69.4]		
	Δ 2011-2007	23.1	18.4	27.5		
		(3.6)	(4.1)	(4.4)		

Note: Standard deviations are brackets. Standard errors are in parenthesis.

Table 3: Mean test scores in math in Slovakia and the Czech Republic in 2007 and 2011, by cognitive domains and gender

Country	Year	Knowing		Applying		Reasoning	
		Girls	Boys	Girls	Boys	Girls	Boys
Slovakia	2007	494.7	499.2	499.4	506.1	502.6	504.9
		[67.8]	[69.9]	[74.7]	[77.7]	[80.7]	[84.1]
	2011	502.0	509.6	498.7	510.0	505.6	514.0
		[75.0]	[76.7]	[80.7]	[81.9]	[83.2]	[85.1]
	Δ 2011-2007	7.3	10.4	0.7	3.9	3.0	9.1
		(6.4)	(6.9)	(7.0)	(7.1)	(7.4)	(6.8)
Czech Republic	2007	469.2	471.2	489.3	495.6	486.9	490.8
		[55.3]	[62.2]	[71.5]	[76.3]	[77.9]	[83.2]
	2011	493.0	503.3	499.3	514.4	514.1	521.1
		[63.0]	[66.5]	[71.7]	[75.5]	[78.0]	[81.6]
	Δ2011-2007	23.8	32.1	10.0	18.8	27.2	30.3
		(4.2)	(4.7)	(4.4)	(4.7)	(4.9)	(6.0)

Note: Standard deviations are brackets. Standard errors are in parenthesis.

Table 4: The number of books at home by country and year (row %)

Country	Year	0-10	11-25	26-100	101-200	200+
Slovakia	2007	11.0	32.9	36.9	11.3	8.0
	2011	11.4	24.9	38.6	15.0	10.0
Czech Republic	2007	6.6	27.7	40.5	14.8	10.4
	2011	6.2	21.7	42.0	17.8	12.2

Table 5: Impact of admission exams on students achievements (treatment effect under various specifications)

Dependent variable:	(1)		(2)		(3)	
standardized math test scores	Girls	Boys	Girls	Boys	Girls	Boys
Treatment	0.134***	0.180***	0.211***	0.222***	0.125***	0.220***
	(0.044)	(0.038)	(0.031)	(0.030)	(0.046)	(0.074)
Treatment*Excess demand					0.245**	-0.002
					(0.117)	(0.131)
Excess demand					-0.110***	0.018
					(0.032)	(0.043)
Controls			Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	6,945	7,134	6,942	7,129	6,942	7,129
Adj. R^2	0.083	0.089	0.199	0.202	0.200	0.201

Note: Standard errors robust to clustering at the year and country level in parenthesis.
*p<0.1 **p<0.05 ***p<0.01

Table 6: Impact of admission exams on students achievements (Quantile regression)

Dependent variable: standardized math test scores	(q10)		(q25)		(q50)		(q75)		(q90)	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Treatment	0.108	-0.034	0.116	0.160***	0.135***	0.289**	0.121	0.322***	0.168**	0.238***
	(0.094)	(0.104)	(0.097)	(0.055)	(0.024)	(0.120)	(0.082)	(0.052)	(0.088)	(0.051)
Treatment*Excess demand	0.173	0.245	0.211*	0.019	0.251***	-0.117	0.283***	-0.068	0.417***	0.161***
	(0.111)	(0.184)	(0.120)	(0.113)	(0.064)	(0.201)	(0.098)	(0.140)	(0.106)	(0.051)
Excess demand	-0.165*	0.158	-0.127***	0.074	-0.101**	0.013	-0.117**	-0.149	-0.158*	-0.160***
	(0.093)	(0.105)	(0.042)	(0.136)	(0.046)	(0.139)	(0.043)	(0.091)	(0.092)	(0.054)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6,942	7,129	6,942	7,129	6,942	7,129	6,942	7,129	6,942	7,129

Note: Standard errors robust to clustering at the year and country level in parenthesis. Standard errors are bootstrapped using 100 replications.
*p<0.1 **p<0.05 ***p<0.01

Table 7: Probability of student's admission to Academic School (marginal effects after Probit model)

Dependent variable: Probability of being admitted	(1)
Math score from TIMSS	0.063***
	(0.005)
Boy	-0.017**
	(0.007)
Age	-0.009
	(0.009)
Books at home:	
10-25 books	0.029
	(0.034)
26-100 books	0.043
	(0.029)
101-200 books	0.073
	(0.045)
more than 200 books	0.124**
	(0.060)
District controls	Yes
N	3,191
Pseudo R^2	0.174

Note: *p<0.1 **p<0.05 ***p<0.01

Table 8: Impact of admission exams on students achievements, controlling for the distance from admission threshold

Dependent variable:	(1)		(2)	
standardized math test scores	Girls	Boys	Girls	Boys
Treatment	0.193***	0.153***	-0.081	-0.022
	(0.069)	(0.049)	(0.101)	(0.086)
Treatment*Distance	-0.002*	-0.002**	-0.001	-0.000
	(0.001)	(0.001)	(0.002)	(0.001)
Treatment*Distance*Excess d.			-0.006***	-0.003*
			(0.002)	(0.002)
Treatment*Excess demand			0.603***	0.367***
			(0.163)	(0.130)
Distance	-0.030***	-0.031***	-0.031***	-0.032***
	(0.003)	(0.002)	(0.003)	(0.002)
Distance *Excess demand			0.002	0.001
			(0.002)	(0.001)
Excess demand			-0.108	-0.027
			(0.066)	(0.073)
Controls	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes
N	6,942	7,129	6,942	7,129
Adj. R^2	0.712	0.730	0.713	0.731

Note: Standard errors robust to clustering at the year and country level in parenthesis.
*p<0.1 **p<0.05 ***p<0.01

Table 9: Treatment effect by cognitive subgroups and gender

Dependent variable:	Baseline		Knowing		Applying		Reasoning	
standardized math test scores	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Treatment	0.125***	0.220***	0.147**	0.201***	0.061	0.098	0.230**	0.175**
	(0.046)	(0.074)	(0.060)	(0.070)	(0.069)	(0.079)	(0.111)	(0.071)
Treatment*Excess demand	0.245**	-0.002	0.293**	0.103	0.233**	0.019	0.210*	0.025
	(0.117)	(0.131)	(0.121)	(0.113)	(0.092)	(0.123)	(0.128)	(0.131)
Excess demand	-0.110***	0.018	-0.082*	0.020	-0.097***	0.059	-0.080*	0.023
	(0.032)	(0.043)	(0.047)	(0.108)	(0.033)	(0.058)	(0.047)	(0.058)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6,942	7,129	6,942	7,129	6,942	7,129	6,942	7,129
Adj. R^2	0.200	0.201	0.225	0.229	0.187	0.190	0.177	0.184

Note: Standard errors robust to clustering at the year and country level in parenthesis.

*p<0.1 **p<0.05 ***p<0.01