Does school choice affect student performance and public school quality?*

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Abstract

This paper studies the relationship between school choice and student performance for high school students in Norway. The analysis exploits both the fact that the degree of school choice formally differs between counties, and detailed information on travelling distances to high schools which more closely reflects the students' actual school choice possibilities. Information on students' residence, high school location, and the degree of formal school choice is used to estimate the effect on student achievement in a difference-in-differences-in-differences model specification. In addition, I estimate the effect of school choice on high school graduation rates and university attainment. I find a positive and significant effect of school choice on student performance, and heterogeneity analyses show that this effect is entirely driven by boys.

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1. Introduction

The increased trade and globalization have coincided with a reduction in the relative demand for unskilled labor in developed countries. Developed countries need high quality educational systems in order to deliver a high skilled workforce, which can compete on global markets with relatively high wages. In this setting, high school education is very important as a starting point for higher education. Large amounts of resources are spent on public schooling in rich countries such as the United States and Norway. However, this is not fully reflected in results from international comparable student tests. These countries have similar levels of performance on OECD PISA tests as countries that spend less than half as much per student, such as Estonia, Hungary and Poland, (OECD, 2012).[1] Thus, do public schools face the right incentives to provide education efficiently? One possible efficiency enhancing policy is to allow students and parents greater freedom through school choice. As a result, I exploit information on students' residence, high school location, and the degree of formal school choice to estimate the effect on student achievement in a difference-in-differences-in-differences model. I examine both student performance in high school, the probability of graduating from high school and the probability of enrolling in higher education.

Several papers highlight two main mechanisms why school choice may increase the overall quality of schooling.[2] First, competition could be an important factor. Competition might improve the schools incentives, since they may be forced to improve when faced with competition instead of just being local monopolies. This is the main motivation for this paper. Will public schools subject to competition produce higher achieving students? A much discussed paper by Hoxby (2000) concludes that a greater degree of Tiebout choice in the US increases public school productivity.[3] The second argument, that private schools may generally be better than public schools, is not relevant in this case. Since only about five

[1] These results are important because they could be one way of predicting future economic growth. See Hanushek and Kimko (2000), Hanushek and Woessmann (2008), and Hanushek and Woessmann (2009).
[2] See Friedman (1962). More recent examples include Hsieh and Urquiola (2006), and Bölhmark and Lindahl (2008).
[3] See also Rothstein (2007) and Hoxby (2007).

percent of Norwegian students attend a private high school, the present analysis is limited to students enrolled in public high schools only.[4]

However, school choice may not be positive for all students. Epple and Romano (1998) suggest that high ability students may create positive spillover effects onto other students. Hence, the sorting effects of school choice could be negative for average performance. It could lead to a system where high ability students select themselves to some particular schools, and the positive spillover effects for these students are not enough to counteract the negative effect for the other students who miss out on these positive peer effects, (Epple and Romano, 1998). In addition, school choice could lead to the most involved families selecting themselves to a few schools reducing the monitoring of other schools, which increases incentives for these schools to reduce their effort in educating the students, (McMillan, 2004).

An empirical challenge when analyzing the effect of school choice is omitted variables. One cannot simply compare students subject to or not subject to school choice, because there could be both observable and unobservable differences across choice regimes. I include a wide range of socioeconomic characteristics in the empirical model, but there may still be unobserved variables that affect student performance. To control for these additional omitted factors I perform a difference-in-differences-in-differences analyses.

In Norway, counties are responsible for high school education, and some of the 19 counties offer school choice between all high schools in the county. I denote this formal school choice. Some counties have a system with neighborhood catchment areas, and thus do not offer school choice. Hence, formal school choice is decided by local county authorities. I also exploit the fact that even though a student lives in a county with formal school choice, actual choice might be limited due to few high schools nearby the student's residence, which results in long travelling distances. This could affect student performance. I address this issue by including a geographical variable measuring potential school choice, based on an indicator that shows travelling distances from the students' residences to nearby high schools. As a

[4] A third argument in favor of school choice, presented in Gibbons et al. (2008), suggests that school choice also could be welfare-improving through reallocation of students to schools that better match their preferences and needs.

result this paper analyzes educational outcomes for students subject to different degrees of school choice.

Student performance is measured as the difference between the grade in Norwegian language obtained in high school and in compulsory education. Thus, the regression model could be interpreted as a difference-in-differences-in-differences specification. The results show a positive and significant effect of school choice on student performance. However, heterogeneity analyses show that his effect is entirely driven by boys. In addition, I also find a positive effect on both high school graduation and the probability of attending higher education.

The paper is organized as follows: Section 2 reviews the relevant literature, and section 3 summarizes important institutional features. Section 4 presents the data and descriptive statistics, while endogeneity issues and identification strategies are discussed in section 5. The results together with some robustness checks are reported in section 6. Section 7 concludes.

2. Literature

This paper explores possible effects of school choice, and is closely related to the literature on school vouchers. The introduction of vouchers often leads to a larger degree of school choice, because vouchers lower cost of private schooling. This makes private schools a more realistic option, especially for low-income students.

Figlio and Hart (2010) estimate the effect of a school voucher, for low-income students in Florida, on student performance. In addition to the voucher they also use geographical variables, to account for actual private school options available to the students. More specifically they examine whether students in schools that face a greater threat of losing students to private schools, due to the introduction of the voucher, improve their test–scores more than students in schools that face less pronounced threats. Due to the annunciation of the program one year ahead of implementation, Figlio and Hart (2010) are able to estimate the pure competition effect in a difference-in-differences framework.

I follow the approach of Figlio and Hart (2010) and introduce geographical variables in the empirical model. However, while they compare students subject to different degrees of

private school options before and after a policy change, I compare students in counties with different degrees of formal school choice. Figlio and Hart (2010) find that public schools subject to more competitive pressure from private schools raised their test scores the most following the introduction of the voucher.

The present analysis does not examine the introduction of a voucher or choice between private and public schools, but simply differences in public school choice across counties in Norway. This is similar to Lavy (2009), who investigates dropout, student achievement, and behavioral outcomes in Israeli public schools. He exploits the termination of an inter-district busing program in Tel-Aviv that led to school choice between public schools. By using two identification strategies, including difference-in-differences estimations and an RD design, Lavy (2009) finds positive effects for all outcomes.

To my knowledge few analyses on school choice have been conducted using Norwegian data. However, Machin and Salvanes (2010) use the transition from rigid neighborhood catchment areas to school choice, in Oslo in 1997, to investigate the effect on housing prices. After the choice reform Machin and Salvanes (2010) show that the house price-school performance relationship was significantly weakened, indicating that parents value better performing schools. Haraldsvik (2012) investigate the effect of a similar school choice reform in another Norwegian county, Hordaland, in 2005. She looks at the effect of students' performance in junior high school when admission to high schools changes from neighborhood catchment areas to school choice. Haraldsvik (2012) finds an increase in student performance when school choice is implemented. Both these papers look at a reform in one specific county, while this paper looks at the whole country, and explores variation across many counties interacted with the students' actual choice possibilities.

Several other papers examine the effect of a general school choice reform on student achievement. Hsieh and Urquiolo (2006) and Bölhmark and Lindahl (2008) look at a nationwide school reform, in Chile and Sweden respectively. In Chile, provision of vouchers opened up for school choice between both private and public schools. By comparing municipalities with different private school enrollment, Hsieh and Urquiolo (2006) find no effect on educational outcomes measured by test scores, repetition rate, and years of schooling.

Bölhmark and Lindahl (2008) investigate both short- and long-term effects of a nationwide school reform in Sweden in 1992. Prior to the reform, public schools were local monopolists on local school markets. With the reform came introduction of vouchers and choice between public and private schools. The authors use within municipality variation to examine if higher private enrollment at the compulsory school level affected overall student performance at the compulsory school level and overall long-term educational achievement. They estimate only small effects on student performance, and no effects on long-term educational outcomes. Other examples in this category include Gibbons et al. (2006), who examines choice and competition effects in the UK, and Ladd and Fiske (2003). Using data from New Zealand, Ladd and Fiske (2003) conclude that competition, as perceived by teachers, have negative effects on student learning.

Papers studying smaller choice programs exploit lotteries to ensure random assignment of treatment. Howell et al. (2000) and Krueger and Zhu (2004) investigates early voucher programs in the US, while Angrist et al. (2002) study vouchers distributed through lotteries in Columbia. Howell et al. (2000) estimate a positive effect on test scores for African American students who switched from public to private schools. However, Krueger and Zhu (2004) claims that this result is sensitive to the sample size and race/ethnicity definitions. Angrist et al. (2002) find that lottery winners have increased educational attainment and academic achievement.

Motivated by the literature on performance by the genders under different incentive schemes, I examine if boys and girls respond differently to school choice Gneezy et al. (2003) investigates performance under different incentive schemes and their findings suggests that women are less effective than men in competitive environments. While Paserman (2007) finds that woman are significantly more likely than men to hit unforced errors at crucial stages of tennis matches in Grand Slam tennis tournaments. Örs et al. (2008) examine an entry exam to a very selective French business school, and find that males perform relatively better than females on the exam compared to prior achievement.[5]

[5] Falch and Naper (2011) uses Norwegian data to investigate whether gender gaps in student achievement is related to evaluation schemes. They find that compared to scores at high-stakes central exit exams, girls get significantly higher grades than boys when assessed by their teacher. Falch and Naper (2011) investigate if the gender gap increases in counties with formal school choice, but they find that girls actually perform better in a more competitive environment.

Cullen et al. (2006) and Hastings et al. (2006) also exploits school admission based on lotteries. However, these papers examine choice between public schools only. While neither of the papers find positive academic outcomes for the average student, Hastings et al. (2006) find significant test score gains for children of parents whose choice revealed a strong preference for academic quality. A third paper investigating a public choice plan is Hastings and Weinstein (2008). They use two experiments to analyze the effect of information on school choice and academic achievement. By making information about school-level performance transparent and easily accessible for low-income families, the authors believe that school choice increased. When parents were informed of the school's academic achievement more parents chose higher-scoring schools for their children. Hastings and Weinstein (2008) also examine the effect of attending a higher scoring school on student performances, and find positive effects. Another paper targeting school choice for low-income families is Rouse (1998). She exploits a Parental Choice Program for a small group of low-income families in Milwaukee. Rouse (1998) compares test scores of students selected to attend a participating private school, with those of unsuccessful applicants and other students from the Milwaukee public schools. Her findings indicate a positive effect on math test scores for students in the choice program.

Overall, the evidence of school choice programs and reforms on student performance is mixed. This motivates further research and alternative identification strategies like the one presented in this analysis. As it is not clear that choice options and competition affects boys and girls equally it is interesting to look at possible differences in student performance for boys and girls in more and less competitive areas.

3. Institutions

Compulsory education in Norway consists of 10 years of schooling from age 6 to age 16. [6] Everybody graduates from compulsory school at the end of 10th grade, grade repetition is non-existing. [7] After finishing compulsory education, students may choose to leave school or

[6] The school system in Norway is relatively homogenous. Less than two percent of all students attend a private compulsory school. Private high schools enroll about five percent of the students.

[7] This indicates that students are supposed to be of the same age at the end of compulsory education. However, there are some exceptions. It is possible to start one year ahead the birth cohort and the student may postpone starting school with one year if not considered mature enough. The parents together with the school and psychologists make this decision.

continue with a non-compulsory high school education. Over 95 percent of each cohort chose the latter.

When starting high school, students could choose between 15 different study tracks in the empirical period. Students enroll in two broad categories of study tracks: Academic study tracks and vocational study tracks. An academic study track consists of three years of schooling and leads to a high school diploma, which is required for university enrollment. Vocational study tracks certify for work in a number of jobs and include industrial design, health and social work, mechanics, and electrical trades. The general academic study track is the largest track and includes about 50 percent of enrolled students.

At the end of compulsory education all students receive a diploma containing 13 grades in different subjects on a scale from 1 (low) to 6 (high), set by teachers. Norwegian language is one of the 13 grades. There is also a final written exit exam at the end of compulsory education. The Norwegian Directorate for Education and Training prepares the exams, while local authorities assign examination subjects to schools and individual students, given clear instructions from the Directorate. Neither the teachers nor the schools have any influence in this respect. The exam results are determined anonymously by two external examiners assigned to each student. However, students are chosen to complete an exam in Norwegian language, English language or mathematics. Around 20 percent of the students take the written exit exam in Norwegian language at the end of compulsory education.

All students graduating from an academic study track in high school have to complete an externally given exit exam in Norwegian language. This national exam is identical for all these students, and graded on a scale from 0 (low) to 6 (high).[8] A grade of 2 or higher is required to pass the exam and graduate from high school. The dataset only includes students that both passed the exam and graduated from high school. I focus on students completing an academic study track, and obtain a value added student performance measure based on the teacher set grade in Norwegian language from compulsory education and the exam grade in Norwegian language from high school.

[8] National exams are given in other subjects as well, but these subjects vary across students due to different study programs.

Municipalities are responsible for compulsory education, while counties are responsible for high school education. Providing high school education is the counties most important task, and accounts for over 50 percent of total county spending. The counties are financed by grants from the central government. Students are allocated to elementary and junior high schools based on fixed neighborhood catchment areas. The counties, however, employ different admission policies. Some counties define specific catchment areas, some have school choice and student selection based on achievement in compulsory school, while others have quasi-systems. Examples of these quasi-systems include students being allowed to choose freely within a certain area of the county, or have the nearest school as a mandatory first choice, but choose the second and the third school freely. That way, students in the same county may experience different degrees of choice, because choice options vary within different areas. I focus on counties where all students faced the same system, either school choice or no school choice and strict neighborhood catchment areas.

The counties vary in their size, population and degree of urbanization. All these factors influence the density and location of high schools within each county. This will also affect high school choice options. Thus, even though a student lives in a county with formal school choice, actual choice might be limited due to few high schools nearby and long travelling distances. Causal evidence indicates that the variation in school choice across counties is mostly historical. Even though school choice has an ideological bias, there are few changes the last 20 years, (Falch and Naper, 2011)[9]. Figure 1 shows changes in number of high schools in Norway from 1993 to 2009. It might seem like there is a dramatic reduction in number of high schools over the last 20 years, but in most counties it is actually just reorganization. A lot of smaller schools have been merged with bigger schools and now only count as one school in official records. Figure 2 presents changes in number of high schools divided by the three different choice systems. The figure shows the same trend for all three categories.

Students have a legal right to enroll in one out of three individually ranked high school study tracks, a rule that is followed without exception by each county. Whether the students are

[9] Some changes occur. Oslo changed from a mixed system to a system of school choice in 1997, see Machin and Salvanes (2010). In the city of Trondheim the exact opposite changes was implemented after the empirical period of this paper, while more choice has been introduced in Bergen. The arguments for changes are typically ideological.

enrolled in the first, second, or third preferred track depends solely on their grade point average (GPA) form compulsory education. All students have a legal right to complete high school, within a time frame of five years.[10] The main rule for high school applicants is to apply in their county of residence.[11]

4. Data and descriptive statistics

The student data, including family- and individual characteristics, and grade information, is obtained from the National Educational Database in Statistics Norway. It consists of all students finishing compulsory education during the years 2002-2004. The student information is matched with information on their parents and school identifiers for both the compulsory school from which they graduated, and the high school in which they enrolled. Individual- and family variables include information on gender, immigration status, birth month, parents' level of education, income status, labor market status, and marital status, and two health variables. I limit the sample to normal-aged individuals i.e. those who turned 16 in the year they started high school.

Details on data reduction are showed in appendix table A1. As can be seen from this table, limiting the sample to students who completed an academic study track reduces the number of observations with over 50 percent. 1.44 percent is missing school owner status and, a very small proportion of about two percent of the students were enrolled in private high schools. The main regression sample only includes individuals living in a county with a clear choice policy, either formal school choice or neighborhood catchment areas. Students living in counties with so-called quasi-systems, where choice options vary within the county, are excluded, reducing the sample with about 10 percent of the observations. I include only the students that passed the Norwegian exam at the end of high school within five years of completing compulsory education.

Formal school choice

School choice possibilities differ between counties, since the choice decision is made by local county authorities. The school choice data are from Haraldsvik (2004). In her classification, school choice is measured on a scale from 0 to 1 with municipalities as the measurement unit.

[10] There is an option for students to apply for a transfer to another school or study track.
[11] There are some exceptions for private high schools and high schools abroad. In addition, some counties have agreements with neighboring counties for students living close to the county boarder.

Municipalities with formal school choice are given the value 1, while municipalities with no choice are given the value 0. Municipalities with some degree of choice are given the value 0.2, 0.5 or 0.8 depending on the degree of choice, where a higher number represents more formal school choice. Counties with municipalities in one of these categories between 0 and 1 is defined as quasi-systems, and excluded from the analysis.

Table 1 presents the different degrees of choice for all individuals divided by county and municipalities. Included in this table is the regression sample and students living in couties with quasi-systems. The table shows that 9 of the 19 counties have school choice in all municipalities, which accounts for about 50 percent of the students. Around 26 percent of the students live in counties with quasi-systems, while 23 percent of the students have no school choice at all.

In the main analysis I focus on counties that provide equal opportunities to all its students, either formal school choice for all students in the county or no school choice at all. Hence, I only use variation across counties in the main regressions. However, I will perform a robustness analysis where counties with quasi-systems are also included. Descriptive statistics for the most important variables are presented in Table 2.

The table shows that the average grade in Norwegian for all students graduating from an academic study track is 3.45, and the average grade in Norwegian from compulsory education is 4.37. Girls perform better than boys in Norwegian in both compulsory education and in high school. There is a higher share of girls in the dataset, due to the fact that more girls start an academic study track,. Girls also have a higher probability of enrolling in higher education. About the same share of boys and girls have formal and potential school choice, while a higher share of girls graduates from high school. When examining the high school graduation the sample is slightly changed since the original regression sample only includes students that have graduated.

Potential school choice

Norway is a sparsely populated country and high schools are often localized in cities and community centers. This will affect choice options for students living in counties with formal school choice. Long travelling distances to nearby high schools will reduce actual school

options for these students. And long commuting distances might also affect student performance. I address this issue by introducing a variable which represent potential school choice in the form of a geographical measure that takes into account numbers of high schools nearby the student's residence. Norway is divided into 14 000 wards, where a ward is a small geographical unit, and the geographical variable includes information about the student's residence measured at the ward level. Hence, it gives a very good indication of the student's location.

The geographical measures are provided by Falch et al. (2013). The variable is defined as a dummy variable equal to 1 if there are more than five high schools within a 30 minute drive from the student's residence. Detailed data on the public road network are used to identify both the length and speed limit for each road segment. Then the number of schools within 30 minutes of driving from the student's residence is calculated using ArcGIS Network Analyst. For further details on the geographical variable see Falch et al. (2013). Table 3 shows that over 70 percent of the students in the regression sample had more than five high schools within a 30 minute drive from their residence. In counties with formal school choice 76 percent of the students have more than five high schools nearby, while this is the case for 14 percent of the students living in counties without formal school choice.

The dependent variable

In the baseline model student achievement will be a value added measure. It is the difference between the grade in Norwegian from high school and the grade in Norwegian from compulsory education. The grade from high school is the grade from the external written exit exam in Norwegian language at the end of high school at the academic study track. Table 3 shows that students subject to school choice had an average high school grade of 3.47, and the students with no school choice had an average high school grade of 3.41. The average grade in Norwegian from compulsory education shows an opposite pattern. Students with no choice had a higher grade in Norwegian language on average.

I will also examine the effect of school choice on the probability of graduating from high school and the probability of being enrolled in higher education five years after the completion of compulsory education.

Descriptive statistics for the control variables

Appendix table A2 presents descriptive statistics for socioeconomic characteristics and other control variables. Hence, the table the population of students in the relevant cohorts that graduates from high school, and consists of 49,367 individuals. This is the sample consistent with a clear county policy regarding formal school choice. There are over 50 percent girls in the sample, 2.2 percent are first generation immigrants and 2.1 percent second generation immigrants. 7.4 percent of the students have parents with no schooling beyond compulsory education, while over 50 percent have parents with higher education, (bachelor degree or higher).

Benefits due to disabilities or diseases before the age of 18 are received by 1.5 percent of the sample, while 1.6 percent has received benefits to support needs for private nursing or care. Around 70 percent of the individuals have married parents, while 11.2 percent have divorced parents. Over 75 percent of the students had two employed parents. The students are pretty evenly distributed over the three cohorts.

5. Identification

I want to compare student achievement in counties with and without school choice, because school choice could have a competitive effect on public schools. However, it might not be random which counties that have formal school choice, and were different families and students are located. I exploit the fact that the relevance of formal school choice depends on the number of high schools nearby the student's residence, (potential school choice). Hence, actual school choice is a combination of both having formal school choice and potential school choice. In addition, a reasonable assumption is that past academic achievement affects current academic achievement. To address this issue, student achievement is measured as the difference between the student's performance in Norwegian language in high school and compulsory school.

I include a wide range of controls in the model, but there could still be omitted variables causing biases in the estimated effects. As formal school choice is decided by the local county authorities, political composition could by an omitted variable. Political composition could be correlated with school choice, due to the fact that non-socialists generally are supporters of

more choice in the educational system. If number of non-socialists in the county council also affect student achievement this could bias the estimates.

In the baseline model I control for omitted variables by performing a difference-in-differences-in-differences estimation. The first difference is the difference in student achievement between high school and compulsory education. This is the dependent variable. Due to the geography in Norway, some students have a limited number of high schools nearby. I include a dummy variable equal to 1 if the student had more than five high schools within a 30 minute drive from its residence, which represents potential school choice and an interaction term between potential school choice and formal school choice.[12] Thus, the second difference is between students who have or don't have formal school choice, and the third difference is between students who are subject to formal school choice and have or don't have potential school choice.

The model is given in equation 1:

$$1.\ E_{igct} - E_{igct-1} = \alpha_c + \beta_0 + \beta_1 SC_c + \beta_2 R_{gc} + \beta_3 SC_c * R_{gc} + X_{igc}\beta_4 + \varepsilon_{igct}$$

where E_{igct} is student achievement in high school for student i in ward g in county c at time t and E_{igct-1} is lagged student achievement from compulsory education. α_c is county fixed effects, SC_c is a dummy variable equal to 1 if county c have formal school choice, and R_{gc} is a dummy variable equal to 1 if there are more than five high schools within a 30 minute drive from the student's residence, (potential school choice). X_{igc} is a vector of the control variables presented in appendix table A2, and ε_{igct} is the error term. The parameter of interest is β_3, and this interaction term shows the effect of school choice for students that have both formal and potential choice compared to those with no choice.

The present paper is different from some of the other studies concerning school choice, as it does not include any analysis of the private school market. I do not investigate the results of a major reform in the Norwegian school system like the introduction of a voucher or a change

[12] Later, I present results from specifications altering both travel time and number of schools.

in the schooling law as in Bölhmark and Lindahl (2008) and Hsieh and Urquiola (2006). I only examine public schools and the possible extra competition effect in counties where students face both formal and potential school choice. Due to the small percentage of students in private high schools there should be no sorting problem regarding which students that enroll in public high schools. Motivated by the literature that suggests differing performance by boys and girls under various incentive schemes, I perform separate regressions for each of the two genders.

Robustness

There could be some additional omitted variables regarding previous achievement. As a result, I include grade point average (GPA) from compulsory education as a control variable. Bölhmark and Lindahl (2008) argue that one reason why they were unable to find long-term effects of school choice might be due to the fact that public schools didn't raise their quality, but only changed the grading standards. Figlio and Hart (2010) criticize their analysis for not having an objective measure of test scores. The lagged achievement measure included in this analysis is the grade in Norwegian language set by teachers, at the end of compulsory education. It is possible endogeneity problems connected to this grade measure, as it is not an objective measure of achievement. There is some evidence that grading practices vary across teachers, see for example Figlio and Lucas (2004) and Bonesrønning (2004). This indicates that the teacher set grade in Norwegian language measures lagged achievements with some error. To the extent that this varies across counties, it is captured by the county fixed effects. However, to further address this measurement problem, I perform a robustness check where I use the result on the externally graded exit exam in Norwegian language from compulsory education instead of the grade set by the teacher. The students are randomly assigned to an exam in Norwegian language, English language or mathematics. Thus, a disadvantage with this approach is the small number of students actually assigned to take the exam in Norwegian language, only about 20 percent.

To avoid the problem with few observations I instrument the teacher set grade in Norwegian with the exam grade from the actual exam completed at the end of compulsory education. In addition, this model includes dummy variables for each exam subject, to control for differences in average grading. In this model specification the grade from compulsory education is moved to the right-hand side in order to be instrumented.

As mentioned earlier, the main analysis excludes counties with so-called quasi-systems. I will estimate a regression including students living in these counties. School choice was relatively stable over the three years when the cohorts start high school. However, there were a few changes in 2005. Since students have a legal right to five years of high school education students may transfer to another school or study track after one or two years of schooling. To try to address this issue I perform an analysis only including students that finished high school in three years and graduated on time.

Hastings et al. (2006) couldn't find any effects of attending a first choice school for the average student, but estimated positive effects for students whose parents placed high weights on school test scores. I perform some heterogeneity analyses including students with different GPA level and parental education level.

6. Results

Results from simple descriptive statistics of the difference-in-differences-in-differences are presented in table 4. Panel A presents only students living in counties with formal school choice. The panel shows the difference in grades from high school and compulsory education for students with and without potential school choice, Panel B presents similar data, but for students with no formal school choice. Panel C presents the difference-parameters. The simple difference-in-differences-in-differences estimate is showed in the third row of panel C. It is positive, and indicates that living in a county with formal school choice and, in addition, having more than five high schools to choose between, increases student performance with 0.13 grade points. This is an effect of 11.7 percent of a standard deviation of the value added measure.

The same estimate is replicated in column (1) of table 5. No controls are included in this model. The effect of school choice, which is an interaction between formal school choice and potential school choice, is highly significant. In column (2) fixed county effects are included in the model. The school choice coefficient is reduced in magnitude, but still highly significant. Column (3) is the baseline difference-in-differences-in-differences regression and also includes socioeconomic characteristics. The interaction effect is slightly reduced, but positive and significant. Living in a county with formal school choice and having potential

school choice increases student performance with 0.073 grade points and 6.5 percent of a standard deviation of the value added measure. The full model in table 5 is presented in appendix table A2.

Results for several different travel times and number of schools are presented in Figure 3. In Panel A the travel time to at least six different schools spends from 9 to 45 minutes. The effect is stable in the interval between 12 and 30 minutes of travel time. A longer travel time might indicate that the students do not have an actual choice anymore, and may explain the decreasing effect on student performance. In Panel B I vary the number of schools within a travel time of 30 minutes. As expected there is no effect for few schools, but the effect is increasing in number of schools. The effect on student performance is pretty stable in the interval raging from more than five to more than nine high schools. Thus, using more than five high schools in measuring potential school choice seems like a conservative choice.

Robustness

Next, I present some robustness checks of the results. In the literature on gender specific performance under different incentive schemes several papers finds boys to be more responsive to competition. This is supported in my results. Column (2) of panel A in table 6 shows a larger effect of school choice for boys, compared to the baseline regression in table 5, replicated in column (1) in table 6. School choice increases boys' performance with 0.13 grade points. The effect is highly significant. The same regression, estimated just for girls, in column (3), shows a much smaller, insignificant result.

Due to the different effects for boys and girls found in panel A, I will continue to divide the sample by gender to analyze the robustness of this result as well. There could also be some additional omitted variables regarding previous achievement. To control for this I include grade point average (GPA) from compulsory education in the regression model. The results are presented in panel B of table 6. GPA has a negative, significant effect on the grade difference between the high school and compulsory school grade in Norwegian. The effect on school choice is not affected much compared to the baseline regressions in panel A.

In panel C I address the possible problems related to objectivity of the grade measure from compulsory education. The grade in Norwegian language set by teachers is replaced by the

grade from the external exit exam. However, the sample size is reduced to 10,500. The effect of school choice is now much higher, and it also has a lower standard error, being significant at the 1 percent significance level. Column (2) shows a large increase in the effect for boys, which is highly significant, while column (3) shows no significant effect for girls. This is a very small sample, but it does replicate some of the previous effects, which indicates a stronger effect for boys. When replacing the exam grade with teacher set grade on the small sample, the results are similar (not shown in table). This suggests that the baseline OLS regression do not overestimate the results.

To address the problem of small sample size in the analysis above, I perform another robustness check related to the grades on the external exit exam at the end of compulsory education. I use the average of the exam grades in the three different subjects: English language, Norwegian language and mathematics as an instrument for the grade in Norwegian language set by the teacher. In this case the dependent variable will be the exam grade in Norwegian from high school, and the grade from compulsory education will be included as a lagged dependent variable. The results are showed in table 7.

The first three columns show reduced form and first and second stage regressions for the whole regression sample. The F-value in column (2) indicates that the exam grade is a strong instrument. The effect of school choice in column (3) does not change much from the baseline regression in column (3) in table 5. Column (4) and (5) shows the second stage regressions for boys and girls, respectively. The effect of school choice for boys is also here larger than in the baseline regression and statistically significant. There is no effect of school choice for girls.

To compare all the students in the data, not just those who were exposed to full formal school choice or no formal school choice, I present one specification which includes the students who lived in counties with quasi-systems. In panel A of table 8 I have replaced the dummy variable representing formal school choice with a scale variable which takes into account all the different degrees of formal school choice. School choice will then be measured on a scale from 0 to 1 where municipalities are represented with the values of 0, 0.2, 0.5, 0.8 and 1. As before a value of 0 indicates no choice, and a value of 1 indicates formal school choice. Having 0.2 in formal school choice can for example mean that the students have to apply for the nearest school as the first choice, but can choose the second and third school freely within

the county. A value of 0.5 in formal school choice indicates for example that students could choose between the schools in the same city or municipality that they lived in. While with a value of 0.8 students have almost full formal school choice, but there could be a few limitations, for example could the county be divided into two areas, and students can choose freely within the area they live in.

As can be seen from column (1), adding those students with limited choice does not affect the result much. The effect of school choice is somewhat smaller in magnitude and only significant at the 10 percent level. Looking at column (2) and (3) both coefficients for school choice are positive, but the effect is much larger and only significant for boys. This is similar to previous results. To address the issue of some small changes in the choice variable, panel B of table 8 presents results only for the students that graduated on-time. The results are similar to previous regressions. Again, the effect is largest and only significant for boys.

To investigate the non-linearity of the results I split the results into several different sub-samples. In panel A of table 9 I exclude the best students, i.e. those who got the highest grade (6) in Norwegian at the end of compulsory education. Excluding these students does not change the results much. However, in panel B and C I look at students with a Norwegian grade from compulsory education above and below average. It seems like it is boys with a grade below average that are most affected by school choice.

Some further heterogeneity analysis related to parental educational level and GPA level is presented in table 10. Panel A shows that school choice affect both boys with low and highly educated parents. In column (1) in panel B, which includes all students in the regression sample, it is not possible to identify a significant effect for any of the four GPA quartiles. In column (2), on the other hand, I can see that boys in all quartiles, except in quartile 4, are significantly affected by school choice. Girls in all quartiles are not affected.

In table 11 I look at more long-term educational outcomes. Panel A includes a larger sample size due to the fact that I have included those who graduated from a vocational study track as well. Panel B consists of the same regression sample as previously used. School choice increases both the probability of graduating from high school (panel A) and enrolling in higher education within five years of the completion of compulsory education (panel B).

However, column (2) and (3) of both panels shows a much larger and significant effect for girls compared to previous results.

7. Conclusion

In this paper I have investigated the effect of school choice on student achievement using a difference-in-differences-in-differences model spesification. The results show a positive effect, which is statistically significant at conventional levels. However, dividing the sample by gender indicates that boys respond more to choice than girls. This result is robust to a range of different model specifications. It is possible to think of several mechanisms which choice effects could work trough.

Some earlier papers (e.g. Figlio and Hart, 2010) argue that public schools are motivated by competition for financial funding. If they perform badly student enrollment will probably decrease, as will financial funding since funds are connected to student enrollment. This connection between student enrollment and funding is less obvious in the Norwegian school system. An example is small schools which receives additional funding per student, compared to urban schools. Financial funding is probably closer related to student enrollment in a system with a larger density of private schools, where students pay tuition.

Another aspect of the competition argument is teacher sorting. Empirical papers using Norwegian data find that teachers tend to leave schools with a high share of minority students and low student performance.[13] Thus, school choice could lead to competition between schools because they strive to achieve high student performance in order to attract the best teachers.

Another possible effect of school choice is student composition effects. Hsieh and Urquiola (2006) suggest that the choice reform in Chile led to cream-skimming. If school choice changes the composition of students and peer effects are important, for example if high achieving students applied to schools in school choice counties, this could affect the estimates, because better students were attending schools subject to school choice. However, this should not happen in Norway, since students have to apply for a high school in their county of residence. As a result, there should be few peer effects leaking to other counties. I

[13] See Falch and Strøm (2004) and Falch and Rønning (2005).

am not able to explain what kind of mechanisms which affect my results. This is a topic for further research.

References

Angrist, J., E. Bettinger, E. King, and M. Kremer (2002). "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment." *American Economic Review,* 92(5), pp. 1535-1558.

Bonesrønning, H. (2004). "Can effective teacher behavior be identified?" *Economics of Education Review*, 23(3), pp. 169-217.

Böhlmark, A. and M. Lindahl (2008). "Does School Privatization Improve Educational Achievement? Evidence from Sweden's Voucher Reform." IZA Discussion Paper 3691.

Cullen, J. B., B. A. Jacob and S. Levitt (2006). "The Effect of School Choice on Participants: Evidence from Randomized Lotteries." *Econometrica*, 74(5), pp. 1191-1230.

Epple, D. and R. E. Romano (1998). "Competition between Private and Public Schools, Vouchers, and Peer-Group Effects." *American Economic Review*, 88(1), pp. 33-62.

Falch, T., P. Lujala and B. Strøm (2011). "Geographical constraints and educational attainment." NTNU Working Paper No. 9/2011. Regional Science and Urban Economics, forthcoming.

Falch, T. and L. R. Naper (2011). "Education Evaluation Schemes and Gender Gaps in Student Achievement." *Regional Science and Urban Economics,* 42, pp.49-59.

Falch, T. and M. Rønning (2005). "The Influence of Student Achievement on Teacher Turnover." CESifo Working Paper No. 1469.

Falch, T. and B. Strøm (2004). "Teacher turnover and non-pecuniary factors." *Economics of Education Review*, 24, pp. 611-631.

Figlio, D. N. and C. Hart (2010). "Competitive Effects of Means-Tested School Vouchers." NBER Working Paper No. 16056.

Figlio, D. N. and M. E. Lucas (2004). "Do high grading standards affect student performance?" *Journal of Public Economics*, 88(9-10), pp. 1815-34.

Friedman, M. (1962). Capitalism and Freedom. University of Chicago Press.

Gibbons, S., S. Machin and O. Silva (2008). "Choice, Competition, and Pupil Achievement." *Journal of the European Economic Association*, 6(4), pp. 912-947.

Gneezy, U., M. Niederle and A. Rustichini (2003). "Performance in Competitive Environments: Gender Differences." *Quarterly Journal of Economics*, 118(3), pp. 1049-1074.

Hanushek, E. A. and D. D. Kimko (2000). “Labor-Force Quality, and the Growth of Nations.” *American Economic Review*, 90(5), pp. 1184-1208.

Hanushek, E. A and L. Woessmann (2008). “The Role of Cognitive Skills in Economic Development.” *Journal of Economic Literature*, 46(3), pp. 607-668.

Hanushek, E. A. and L. Woessmann (2009). “Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation.” NBER Working Paper No. 14633. Journal of Economic Growth, forthcoming.

Haraldsvik, M. (2004). ”Elevprestasjoner og konkurranse i den videregående skolen: Gir konkurranse om skoleplassene elevene insentiver til å jobbe hardere på ungdomsskolen?” Master thesis, Norwegian University of Science and Technology.

Haraldsvik, M. (2012). “Does Performance-Based School Choice Affect Student Achievement.” Ph.D. thesis, Norwegian University of Science and Technology.

Hastings, J. S., T. J. Kane and D. O. Staiger (2006). “Preferences and Heterogeneous Treatment Effects in a Public School Choice Lottery.” NBER Working Paper No. 12145.

Hastings, J. S. and J. M. Weinstein (2008). “Information, School choice, and Academic Achievement: Evidence from Two Experiments.” *Quarterly Journal of Economics*, 123(4), pp. 1373-1414.

Howell, W. G., P. J. Wolf, P.E. Peterson and D. E. Campbell (2000). “Test-Score Effects of School Vouchers in Dayton, New York, and Washington: Evidence from Randomized Field Trials.” Paper presented at the annual meeting of the American Political Science Association, Washington, DC.

Hoxby, C. M (2000). “Does Competition among Public Schools Benefit Students and Taxpayers?” *American Economic Review*, 90(5), pp. 2026-2037.

Hoxby, C. M. (2007). “Does Competition among Public Schools Benefit Students and Taxpayers? Reply.” *American Economic Review*, 97(5), pp. 2038-2055.

Hsieh, C.-T. and M. Urquiola (2006). “The effects of generalized school choice on achievement and stratification: Evidence from Chile´s voucher program.” *Journal of Public Economics*, 90, pp. 1477-1503.

Krueger, A. B. and P. Zhu (2004). “Another Look at the New York City School Voucher Experiment.” *American Behavioral Scientist*, 47(5), pp. 658-698.

Ladd, H. F. and E. B. Fiske (2003). “Does Competition Improve Teaching and Learning? Evidence from New Zealand.” *Educational Evaluation and Policy Analysis*, 25(1), pp. 97-112.

Lavy, V. (2009). “Effects of Free Choice Among Public Schools.” *Review of Economic Studies*, 77(3), pp. 1164-1191.

Machin, S. and K. G. Salvanes (2010). “Valuing School Quality via a School Choice Reform.” IZA Discussion Paper No. 4719.

McMillan, R. (2004). “Competition, incentives and public school productivity.” *Journal of Public Economics*, 88(9-10), pp.1871-1892.

OECD (2012). “Does money buy strong performance in PISA?” PISA in Focus N. 13 02/2012.

Paserman, D.M (2007). “Gender Differences in Performance in Competitive Environments: Evidence from Professional Tennis Players.” IZA Discussion Paper No. 2834.

Rothstein, J. (2007). “Does Competition among Public Schools Benefit Students and Taxpayers? Comment.” *American Economic Review*, 97(5), pp. 2026-2037.

Rouse, C. (1998). “Private School Vouchers and Student Achievement: An Evaluation of the Milwaukee Parental Choice Program.” *Quarterly Journal of Economics*, 113(2), pp. 553-602.

Örs, E., F. Palomino, and E. Peyrache (2008). “Performance Gender-Gap: Does Competition Matter?” CEPR Working Paper No. 6891.

Table 1 Degree of school choice

Choice	County	Municipalities	Individuals
	Observations	Observations	Observations
Formal school choice	9	152	33,959
No school choice	4	88	15,408
Quasi-systems	6	191	17,653
Total	19	431	67,020

Table 2 Descriptive statistics for the outcome and choice variables

	All		Boys		Girls	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Grade from high school exam in Norwegian language	3.449	0.948	3.373	0.941	3.502	0.949
Grade in Norwegian language from compulsory education	4.371	0.760	4.165	0.769	4.513	0.720
Difference in Norwegian grade between high school	-0,92	0.898	-0,791	0.904	-1,01	0.883
Probability of enrolling in higher education	0.685		0.659		0.703	
Formal school choice	0.688		0.701		0.679	
Potential school choice	0.725		0.705		0.707	
Observations	49,367		20,114		29,253	
Graduated from high school	0.835		0.797		0.868	
Observations	72,497		33,832		38,665	

Table 3 Degree of school choice and some key variables for the regression sample

	All	Formal school choice	No school choice
Grade Norwegian language, high school exam	3.45	3.47	3.41
Grade Norwegian language, compulsory education	4.37	4.36	4.39
More than five high schools Within 30 minutes of driving	0.72	0.76	0.64
Observations	49,367	33,959	15,408

Table 4 Difference-in-differences-in-differences, achievement in Norwegian

Panel A	Formal school choice		
	Potential school choice	Not potential school choice	Difference
High school grade	3.50	3.36	0.14
Compulsory school grade	4.35	4.39	-0.04
Difference	-0.85	-1.03	0.18
Observations	25,958	8,001	33,959
Panel B	No formal school choice		
	Potential school choice	Not potential school choice	Difference
High school grade	3.44	3.37	0.07
Compulsory school grade	4.40	4.38	0.02
Difference	-0.96	1.01	0.05
Observations	9,812	5,596	15,408

Panel C	Difference-in-difference-in-difference
Formal school choice	0.18
No school choice	0.05
Difference-in-differences-in-differences	0.13

Table 5 Effects of school choice

	(1)	(2)	(3)
School choice	0.132***	0.0904**	0.0729**
	(0.0451)	(0.0389)	(0.0328)
Formal school choice	-0.0211		
	(0.0350)		
Potential school choice	0.0500	0.0495*	-0.00377
	(0.0310)	(0.0280)	(0.0240)
County fixed effects	No	Yes	Yes
Socioeconomic characteristics	No	No	Yes
Observations	49,367	49,367	49,367

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice.

Table 6 Robustness analyses related to previous achievement

Panel A. Baseline regression	All students	Boys	Girls
School choice	0.0729**	0.130***	-0.0404
	(0.0328)	(0.0409)	(0.0405)
Observations	49,367	20,114	29,253
Panel B. Including GPA as a control	**All students**	**Boys**	**Girls**
School choice	0.0669**	0.113***	0.0390
	(0.0321)	(0.0378)	(0.0408)
GPA	-0.182***	-0.274***	-0.114***
	(0.00832)	(0.0112)	(0.00903)
Observations	49,367	20,114	29,253
Panel C. Exam in Norwegian in compulsory education	**All students**	**Boys**	**Girls**
School choice	0.149***	0.265***	0.0796
	(0.0520)	(0.218)	(0.0560)
Observations	10,500	4,265	6,235

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Table 7 Models using exam grades as instrument for teacher set grade at the compulsory school level

Sample	Reduced form, All students	1. stage, All students	2. stage, All students	2. stage, Boys	2.stage, Girls
Grade in Norwegian from compulsory education			1.056***	0.963***	1.126***
			(0.0138)	(0.0169)	(0.0197)
School choice	-0.0101	-0.0860**	0.0808**	0.133***	0.0494
	(0.0336)	(0.0346)	(0.0332)	(0.0394)	(0.0416)
Exam grades	0.410***	0.388***			
	(0.00542)	(0.00395)			
English exam	-0.0372**	-0.0355**	-0.00176	0.00498	-0.00675
	(0.0164)	(0.0155)	(0.0200)	(0.0220)	(0.0227)
Mathematics exam	0.0571***	0.0479***	0.00653	0.00922	0.00508
	(0.0151)	(0.0169)	(0.0188)	(0.0216)	(0.0212)
Observations	48,359	48,359	48,359	19,720	28,639
F-value		9655.14			

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Table 8 Different sub-samples related to students' residences and timing of graduation

Panel A. Including counties with quasi-systems	All students	Boys	Girls
School choice	0.0565*	0.102**	0.0302
	(0.0318)	(0.0407)	(0.0385)
Observations	67,020	26,927	40,093
Panel B. Including only students that graduated on time	**All students**	**Boys**	**Girls**
School choice	0.0519	0.120***	0.0143
	(0.0338)	(0.0433)	(0.0425)
Observations	43,492	17,514	25,978

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Table 9 Different sub-samples with respect to grade level

Panel A. Excluding students with the highest grade in Norwegian from compulsory education	All students	Boys	Girls
School choice	0.0679**	0.129***	0.0326
	(0.0327)	(0.0411)	(0.0419)
Observations	47,177	19,609	27,568
Panel B. Excluding students with a Norwegian grade above average from compulsory education	All students	Boys	Girls
School choice	0.0422	0.0996**	-0.00426
	(0.0328)	(0.0410)	(0.0401)
Observations	27,165	13,427	13,738
Panel C. Excluding students with a Norwegian grade below average from compulsory education	All students	Boys	Girls
School choice	0.0539	0.0881	0.0462
	(0.0499)	(0.0672)	(0.0580)
Observations	22,202	6,687	15,515

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Table 10 Heterogeneity related to parental background and GPA level

Panel A. Effect of parental education level on school choice	All students	Boys	Girls
Low educated parents	0.0954**	0.171***	0.0545
	(0.0438)	(0.0521)	(0.0489)
Observations	22 001	7 836	14 165
High educated parents	0.0586	0.108**	0.0236
	(0.0369)	(0.0465)	(0.0590)
Observations	27,366	12,278	15,088
Panel B. Effect of GPA level on school choice	All students	Boys	Girls
GPA in quartile 1	0.0788	0.123*	0.0444
	(0.0482)	(0.0673)	(0.0549)
Observations	14,036	7,083	6,953
GPA in quartile 2	0.0814	0.123*	0.0546
	(0.0503)	(0.0639)	(0.0690)
Observations	12,060	5,317	6,743
GPA in quartile 3	0.0853*	0.200**	0.0430
	(0.0478)	(0.0832)	(0.0624)
Observations	13,560	4,887	8,673
GPA in quartile 4	0.0101	-0.00519	0.0139
	(0.0675)	(0.0852)	(0.0718)
Observations	9,711	2,827	6,884

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Table 11 Graduation from high school and university attainment as outcome variables

Panel A. Graduated from high school	All students	Boys	Girls
School choice	0.0267**	0.0282*	0.0255**
	(0.0128)	(0.0156)	(0.0116)
Observations	72,497	33,832	38,665
Panel B. Higher education	**All students**	**Boys**	**Girls**
School choice	0.0399***	0.0372*	0.0407***
	(0.0105)	(0.0220)	(0.0125)
Observations	49,367	20,114	29,253

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice. The model specifications are similar to the model specification in column (3) in table 5, except as indicated.

Appendix

Table A1 Data reduction

	Observations	Percent of population
Total population. All students graduating from compulsory education in 2002-2004	174 067	100
Didn't finish an academic study track	98 492	56.6
Not 16 when starting high school	1 374	0.8
Missing grade information	375	0.22
Missing school owner status	2 509	1.44
Not enrolled in a public high school	3 400	1.95
Missing choice information	692	0.40
Missing parents marital status	3	0.002
Counties with quasi-systems	17 705	10.17
Students that completed the high school exam in Norwegian over five years after compulsory education	150	0.086
Regression sample	49,367	28.33

Appendix table A2 Descriptive statistics

	Regression sample	
	Mean	Standard deviation
Girl	0.593	
First generation immigrant	0.022	
Second generation immigrant	0.021	
Both parents have compulsory education only	0.074	
At least one parent has a high school education	0.372	
At least one parent has a bachelor degree	0.376	
At least one parent has a master or doctoral degree	0.178	
Benefits due to disabilities or diseases	0.015	
Benefits due to private nursing or care	0.016	
Birth month	6.40	3.353
Parents married	0.70	
Parents divorced	0.112	
Parents never married	0.188	
Parental income in quartile 1	0.213	
Parental income in quartile 2	0.241	
Parental income in quartile 3	0.258	
Parental income in quartile 4	0.288	
Both parents employed	0.777	
Only mother employed	0.085	
Only father employed	0.110	
Cohort 2002	0.322	
Cohort 2003	0.332	
Cohort 2004	0.346	
Number of students at the compulsory school	48.745	27.335
Observations		49,367

*In the regression sample counties with different degrees of choice within the county is excluded.

Appendix table A3 Full results for the regressions in table 5

	(1)	(2)	(3)
Formal school choice	-0.0211		
	(0.0350)		
Potential school choice	0.0500	0.0495*	-0.00377
	(0.0310)	(0.0280)	(0.0240)
School choice	0.132***	0.0904**	0.0729**
	(0.0451)	(0.0389)	(0.0328)
Girl			-0.200***
			(0.00872)
First generation immigrants			0.130***
			(0.0341)
Second generation immigrants			0.105***
			(0.0367)
At least one parent have a high school education			0.00346
			(0.0185)
At least one parent have a bachelor degree			0.0192
			(0.0171)
At least one parent have a master or doctoral degree			0.0951***
			(0.0199)
Benefits due to disabilities or diseases			-0.0144
			(0.0412)
Benefits due to private nursing or care			0.0952**
			(0.0359)
Birth month			0.00930***
			(0.00111)
Married parents			0.000553
			(0.0104)
Divorced parents			0.00345
			(0.0176)
Both parents employed			-0.0209
			(0.0235)
Only father employed			-0.0221
			(0.0254)
Only mother employed			-0.0185
			(0.0247)
Parental income in quartile 2			-0.0176
			(0.0148)
Parental income in quartile 3			-0.0299**
			(0.0115)
Parental income in quartile 4			0.00454
			(0.0138)
Number of students at the compulsory school			0.00266***
			(0.000228)
Observations	49,367	49,367	49,367

Note: Standard errors clustered at the county and cohort level are reported in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. The variable school choice is an interaction between formal school choice and potential school choice.

Figure 1 Number of high schools in Norway from 1993-2009

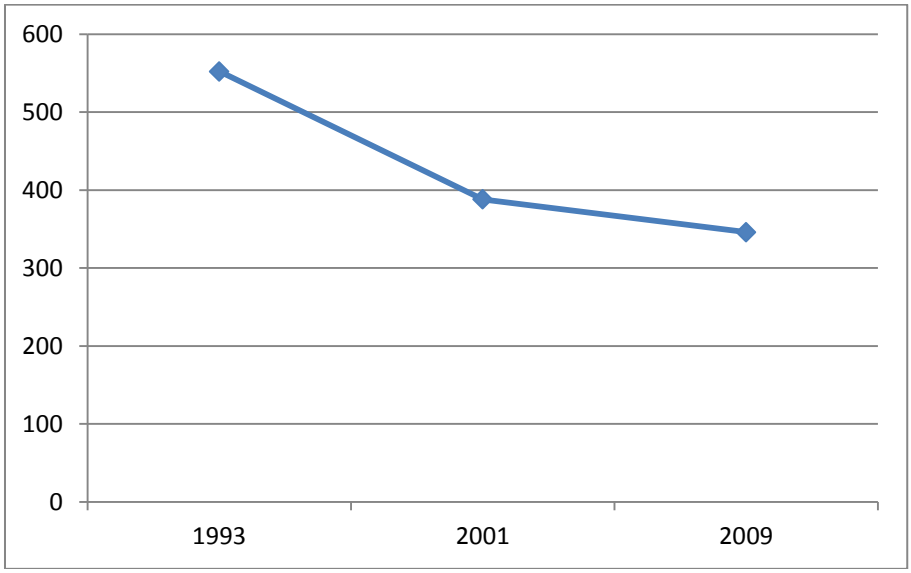


Figure 2 Changes in number of high schools divided by choice systems

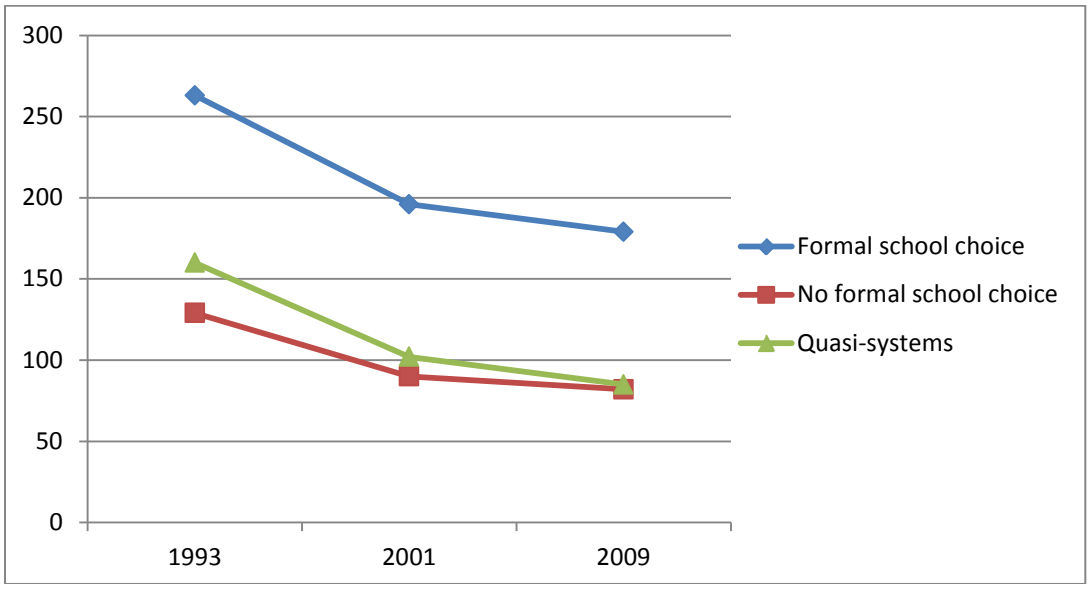
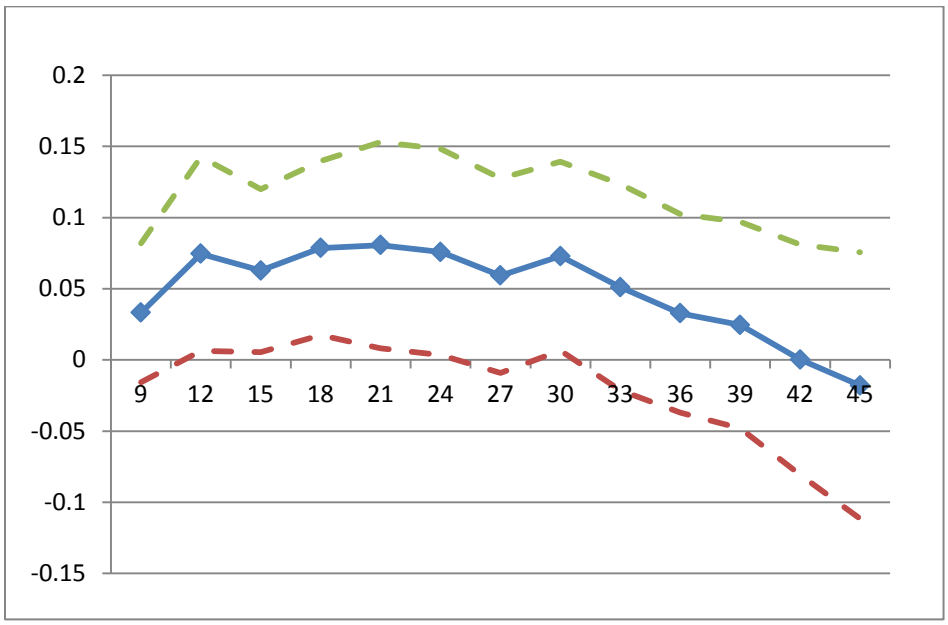


Figure 3 The effect of school choice on student performance with 95 percent confidence interval, different travel time and number of schools

Panel A: Different travel time from the student's residence



Panel B: Different numbers of schools within 30 minutes travel time from the student's residence