VATT-KESKUSTELUALOITTEITA
VATT-DISCUSSION PAPERS

227

SCHOOL RESOURCES AND STUDENT ACHIEVEMENT REVISITED: NEW EVIDENCE USING PANEL DATA

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Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Helsinki 2000

ISBN 951-561-325-6

ISSN 0788-5016

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Yliopistopaino

Helsinki, 2000

HÄKKINEN IIDA, KIRJAVAINEN TANJA, UUSITALO ROOPE: SCHOOL RESOURCES AND STUDENT ACHIEVEMENT REVISITED: NEW EVIDENCE USING PANEL DATA. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 2000, (C, ISSN 0788-5016, No 227). ISBN 951-561-325-6.

Abstract: In this study we analyse the effects of the changes in the school spending on the matriculation examination results. We use a large sample of Finnish senior secondary school students from the years 1990–1998. Teaching expenditure did not have a significant effect on the average test scores. Increase in teaching expenditure did, however, improve test scores in additional language exams. Comprehensive school GPA and parents education are the best explanatory variables for student achievement. Boys perform slightly better, when comprehensive school GPA is controlled for. Work during the school year decreases test scores.

Key words: Senior secondary schools, school spending, student achievement

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Tiivistelmä: Tutkimuksessa analysoidaan koulutusmenojen muutosten vaikutuksia ylioppilaskirjoitustuloksiin. Tutkimuksessa käytetään kattavaa otosta suomalaisista ylioppilaista vuosilta 1990–1998. Opetusmenoilla ei ollut tilastollisesti merkitsevää vaikutusta ylioppilaskirjoitusten puoltoäänien summaan tai yleisarvosanaan. Opetusmenojen kasvattamisella sen sijaan oli pieni positiivinen vaikutus ylimääräisen vieraankielen arvosanaan. Parhaiten kirjoitustuloksia selittää peruskoulun keskiarvo ja vanhempien koulutus. Kun lähtötasoa kontrolloidaan, pojat menestyvät hieman paremmin kuin tytöt. Opiskelijat, jotka käyvät töissä lukukausien aikana, menestyvät kirjoituksissa muita huonommin.

Asiasanat: Lukiot, koulujen resurssit, oppimistulokset

Summary

We examine the effect of school resources on student achievement in Finnish senior secondary schools using a representative sample of students for the years 1990–1998. In this study we use results from the Finnish senior secondary school final exam (matriculation examination), which is compulsory for all students. We have school resource variables attached to each student. The data allow us to control for the time-invariant differences across the schools, and our estimates are based on the within school variation of school spending. Therefore, we can avoid selectivity problems and eliminate neighbourhood effects in a manner that is not possible in cross-section studies. We can also control for various family background differences and the initial level of achievement when students apply for senior secondary schools. The data are obtained from several different registers and contain 21,320 students.

There has been a considerable decline in school resources due to the recession in the early 1990's. Median teaching expenditure per student decreased by 30 per cent from 1990 to 1994. In addition, local government financing system was reformed in 1993. Before 1993 local governments received an earmarked grant for running the school system. After 1993, local governments received a flat grant that they can freely allocate for different functions. As a results of the reform, not only level, but also the changes in school spending vary across municipalities.

The main question of this paper is whether the reduction in secondary school spending has had a negative impact on the matriculation examination results. We estimate fixed effect panel regressions explaining the matriculation examination score with the grade point average in the comprehensive school, parents' education, student’s sex, local unemployment rate, a dummy variable indicating whether the student has been working during the school year, school size, and school's teaching expenditure. Matriculation examination score is defined both as a sum of test scores in six exams and as a mean of test scores in compulsory exams. The results are not sensitive to the specification.

The grade point average (GPA) in the comprehensive school has a very large effect on the matriculation examination results. Also parents’ education has a strong effect on the matriculation exam score, even when the comprehensive school GPA is controlled for. Teaching expenditure had no significant effects on student achievement, whether the dependent variable was the sum of test scores or the mean. Both estimates are very close to zero. Boys perform slightly better than girls and the difference is greater when measured with the average test score.

The school size and local unemployment rate have no effect on student performance, either. Working during school year appears to decrease test scores. How-

ever, adding these variables has no impact on the coefficients of teaching expenditure, family background or GPA. Also the model fit does not improve, the variables explain little less than half of the variance in the matriculation examination scores. About 10 per cent of the remaining variance is attributed to between school variation.

Since it was not possible to divide teaching expenditure between different schools in the same municipality, we repeated the analysis using only private schools and the municipalities with only one senior secondary school. The results on this smaller sample are similar to the estimates including all schools. The only differences are that the coefficient of the school size decreases and appears to be significant, and that boys are not performing better any more.

Although the teaching expenditure do not have any effect on the average or sum of matriculation examination test scores, it has an impact on achievement in additional foreign language exam in the estimated tobit model. The tobit model accounts for both the likelihood that students take the voluntary language test and the performance in the test. As before, the comprehensive school GPA and parents' education are the strongest predictors of the performance in the language exams, but also the teaching expenditure per student appear to have a positive and statistically significant effect. No significant effects were found for other subject exams. So even if cuts in the school spending do not seem to have had a very large effect on the average performance of Finnish secondary school students, it is possible that cuts in spending have had a deteriorating impact on language skills.

We also examine the factors that influence the entry to senior secondary school and the acceptance to universities after the matriculation examination. We observe that parents' education and comprehensive school GPA are the strongest predictors of senior secondary school attendance. Boys were more likely to enter senior secondary school when grade point average is controlled for. It is also found that regional unemployment rate lowers the probability of entering senior secondary school and that probability of entering senior secondary school is higher in the urban areas.

The probit estimates of university enrolment resemble the results on entry to senior secondary school. Scholastic achievement whether measured as sum of test scores in six exams or as mean of test scores in compulsory exams has a strong effect on the probability of being enrolled in a university. Interestingly, also comprehensive school GPA and parents' educational level have a strong positive effect on university entry. Controlling for the examination results, men are more likely to enter university. We also observe that students from the high unemployment areas are less likely, but students from rural areas more likely to enter university.

Contents

1. Introduction

The effect of school resources on student achievement has been examined in hundreds of studies during last thirty years. Still the question is far from settled. Existing studies have failed to show conclusive evidence that more resources or smaller classes improve learning. A recent survey by Hanusek (1998) shows that the studies that report a significant positive association between class-size and achievement are approximately equal in number to the studies that report a significant negative association. However, two thirds of the reported estimates show no significant effects of class-size.

With a wealth of evidence from across the world, one may question whether yet another study on school resources and student achievement can provide any more value added. This study proposes to contribute to the existing literature in the following three ways.

First, most studies on the effects of school resources are based on various standardised test scores. While these scores, no doubt, measure some important aspects of learning, it is not clear that short tests really measure achievement in a reliable way, and that students have the proper incentives to take these tests seriously. On the other hand, the studies that rely on more extensive tests that really matter for students, for example SAT-scores that are used as college admission criteria, suffer from a selection bias, since only a non-random sample of students take part in testing. In this study, we use results from the Finnish senior secondary school final exams (matriculation examination). The matriculation examination is compulsory for all students and the university admission decisions are partly based on the exam. The exam takes place at the same time in all Finnish senior secondary schools and the results are standardised to be comparable across the years. The exam is divided in six subject exams with six hours testing time in each subject. A considerable amount of resources are spent for preparing the students for the exam, and schools are frequently ranked according to the exam results.

Second, we have a representative sample of students in all Finnish senior secondary schools for the years 1990–1998. Nine cohorts of students allow us to control for time-invariant differences across the schools, and our estimates are based on within school variation of school spending. Therefore, we can avoid selectivity problems and eliminate neighbourhood effects in a manner that is not possible in the cross-section studies. We can also control for various family background differences and the initial level of achievement when students apply for senior secondary schools.

Finally, there is considerable variation in school spending within schools over time. This was caused by a severe recession during the early 1990’s. As a result

of poor economic circumstances of the local governments, the average spending per student decreased by approximately 30 per cent between 1990 and 1994. In addition, the local government financing system was reformed in 1993. Before 1993, the local governments received an earmarked grant for running the school system. After 1993, local governments received a flat grant that they can freely allocate for different functions. As a results of the reform, not only level, but also the changes in school spending vary across municipalities.

In this paper we study the effects of the changes in school spending on matriculation examination results using a large sample of Finnish senior secondary school students. The rest of this paper is organised as follows. In chapter 2 we present a brief survey of earlier studies. Chapter 3 summarises the main features of the Finnish senior secondary school system. Chapter 4 describes the data. In chapter 5 we show the recent developments in school resources. Chapter 6 presents the estimation results and chapter 7 concludes.

2. A brief survey of earlier studies

After hundreds of studies on the effect of school resources on student achievement[1] the evidence is still inconclusive. After surveying hundreds of estimates Hanushek (1986, 1996) concluded that there is no systematic evidence on the effect of school resources on student performance. On the other hand, there are some new studies based on high quality experimental data that report significant positive effects of higher resources on student learning.

The results of anglo-american studies on the effect of school resources on student achievement have been recently reviewed by Hanushek. In his latest survey (Hanushek, 1996) he concluded that the resources are not systematically related to student performance. The result was based on 90 studies, and in the majority of cases the parameter estimates of resources were statistically insignificant. As for the separate factors, the strongest relationship seemed to be between teachers' education and student performance; in 29 per cent of the studies the estimated effect was positive. Also expenditure per student had a positive effect on performance almost as often i.e. in 27 per cent of the studies, whereas e.g. teacher-student ratio (class size) had a positive effect on the student performance only in 15 per cent of the studies

Not all agree with the Hanushek's conclusion and survey methods. Hegdes and Greenwald (1996) came to an opposite conclusion in their review which was based on studies analysed by Hanushek, as well as, some additional studies. Their meta-analysis that used combined significance testing (instead of simply counting the significant p-values as in Hanushek's survey) concentrated on three resource factors, namely, teacher-student ratio, teacher education, and teacher experience. Hedges and Greenwald claim that there is evidence on the positive effect on student performance for all these variables.

The effect of resources on test performance was also one of the questions investigated in a recent study by Card and Payne (1998). More specifically, they examined whether the equalisation of spending between rich and poor districts in a state had any effect on student test scores. Based on their estimation results they concluded that there is a modest equalising effect of the school finance reforms on the test score outcomes for children from the different family background groups, although the evidence is not decisive.

Interestingly, studies using students' subsequent earnings as their dependent variable find more often that school resources influence the results. Various reasons for this outcome have been suggested (see e.g. Betts, 1996) relating to both the bias stemming from omitted variables and the nature of data. Omitted vari-

[1] Here, only studies using statistical methods are considered as opposed to studies using e.g. non-parametric methods like Data Envelopment Analysis.

ables problems refer to improper controls, for example, student background. There are two explanations relating to the nature of data used. First, studies finding positive effects, have often used aggregate data (usually state-level resources variables as in Card and Krueger's (1992) widely cited study). It has been suggested that this leads to biases as important variables (for example, variables depicting different state policies) are missing. Alternatively, most studies that explain earnings with school resources and find positive effects, use data with individuals who attended school before the 1960's, whereas studies that use more contemporaneous data, tend to find no effect or only weak effects. This suggests that the relationship between school resources and achievement would have been stronger for earlier cohorts.

As for the aggregation problem, Goldhaber and Brewer (1997) have presented some new evidence that emphasize the need for more accurate data. They used data where students and their teachers in the math class were linked together. According to their estimation results, school level resources did not affect tenth-grade mathematics test scores in most of the cases, whereas class size and teacher characteristics did. Students in smaller classes, and students who had certified teachers or teachers with bachelor's or master's degree in mathematics scored higher. Goldhaber and Brewer also found that certain aspects of teacher behaviour influenced student achievement independently of teacher characteristics, and that unobservable teacher and school characteristics played a role, and these characteristics were uncorrelated with other explanatory variables. These results suggest that studies with individual level data where teachers and students are linked would be needed.

Loeb and Bound (1996) studied the effect of school resources on student achievement using historical data containing cohorts born between 1920's and 1940's. Their data contained information on the measurable school characteristics, such as student-teacher-ratio and length of the school term. Their data showed that both the resources devoted to schools had enhanced, and that the differences in resources diminished during the period these cohorts attended school. When the relationship between school resources and student performance was studied more closely, Loeb and Bound found that (state level) school inputs in the states where the men grew up have a significant positive effect on achievement (reading test results). This finding suggests that the achievement effect may have diminished over time.

As for the pure class size effect on student performance, Hanushek (1998) has also surveyed it more closely. In his review, he once again concluded that there is no systematic support for the advantages of smaller classes. This conclusion holds for both primary and secondary schooling. He did not find support for the idea that with more precise data the class size effect would show up. In a subset of studies all of which were value-added analyses conducted with student level information within one state (23 studies), only one showed that there was a sta-

tistically significant negative relation between class-size and student performance.

Recently, interesting new studies on class size issue have appeared. They have found negative class size effects i.e. students in smaller classes performed better. Krueger (1999) analysed the issue with data obtained from the project STAR which was an experimental study conducted in Tennessee. In the study, kindergarten students and their teachers were randomly assigned to one of the three groupings at the beginning of the 1985–86 school year: small classes (13–17 students per teacher), regular size classes (22–25 students) and regular classes (22–25 students) which also included a full-time teacher's aide. After their initial assignment, the design called for students to remain in the same class type for four years. Some 6000–7000 students were involved in the project each year. Over all four years, the sample included 11,600 students from 80 different schools.

According to the estimation results, there are some effects of attending small classes. Students in smaller classes had better results in standardised tests than students in regular-sized classes, whereas the provision of a full-time teacher aide had only a small effect on achievement. The results also showed that the benefit of attending smaller classes is highest at the end of the first year. After that, additional time spent in small class had a positive but smaller effect. As for other results, teacher experience had a small positive effect on student performance which deteriorated after 20 years of experience. Also this study showed that an increase in the resources, i.e. smaller class size in this case, had a larger effect for minority students and those on free lunch. The results of project STAR suggest that there are gains to attend in smaller classes, at least in the kindergarten and at the elementary school level.

Angrist and Lavy (1999) studied the effect of class size on student performance in the Israeli public schools. They also found that in smaller classes learning was enhanced. Their data was interesting in the sense that there was a considerable exogenous variation in the class size. They used functions of Maimonides' rule[2] as instruments for the class size. Angrist's and Lavy's estimation results showed a consistent negative association between larger classes and reading and mathematics scores. These effects were largest for the math and reading scores of fifth graders and moderate for fourth graders. For third graders no association was found.

Studies investigating the connection between resources and student achievement have been more uncommon outside the anglo-american countries. In Finland, Kirjavainen and Loikkanen (1995) studied the effect of school resources on

[2] Maimonide's rule have been used since 1969 to determine the division of enrolment cohorts into classes in the Israeli public schools. According to the rule, after the class size reaches 40 students a new teacher is appointed. As a consequence class size varies between 21 and 40 students. Maimonide's rule creates exogenous variation for class size.

school performance using cross-section school-level data on the Finnish senior secondary schools. They used both the matriculation examination scores and the final reports scores as a performance measure. According to their results, student background i.e. admission level (lowest accepted score) and parents' educational level affected performance positively. In most of the models, the share of female students had also a positive effect. The achievement was lower in urban areas than in suburban and rural areas. Class size, teachers' education and experience did not affect performance, and in some models the effect was negative. In some of the models school size had a positive effect. When teachers' salaries were used as a resource variable instead of experience and education, they had a positive impact on achievement in some of the models.

In this study, the data contains student specific information on matriculation examination scores, prior achievement, and family background. As for the school resources, we only have school level averages (or municipal level averages for cities with more than one senior secondary school) so we are not able to trace the class-level effects. We have, however, nine cohorts of students some of whom faced the high spending era at the end of 1980's, and some from the period of considerable decline in school spending caused by the recession in the early 1990's. This enables us to study the effect of changes in school resources on changes in student performance.

3. Features of the Finnish secondary schooling system

The senior secondary schools provide three years post-comprehensive general education for students aged from 16 to 19. The school concludes with a national matriculation examination that gives the student the general qualification to apply for a university or for tertiary level vocational studies. Examination is compulsory for all senior secondary school students. It is drawn up nationally, and there is a centralised body to check its individual tests according to uniform criteria. The results are standardised to be comparable across the years. There are four compulsory exams in the matriculation examination: mother tongue, the other national language, foreign language[3] and either mathematics or science and humanities exam[4]. In addition, candidates may voluntarily take additional exams in other foreign languages, or take both the math and the science and humanities exams. Exams are arranged each spring and autumn during a two-week examination period. Each test lasts for six hours. From 1996 onwards candidates have been able to split the examination and complete it within a maximum of three different examination periods. Before, the full exam had to be taken within the same period, usually in the spring term of the senior year.

The admission to the senior secondary schools is selective based on the grade point average (GPA) in the comprehensive school. In practice, application takes place through a national joint application procedure. Roughly 50 percent of the age cohort is accepted[5]. Competition to the best senior secondary schools is harder, and competition is generally harder in larger cities. Therefore, the admission criteria and the average GPA of the students varies considerably across schools.

The responsibility for funding education is divided between the state and the local governments or other education providers. In addition to their own funding, local education providers are entitled to receive a state subsidy for the establishment and operating costs of their institutions. The state grant is calculated based on the number of students using rules that are confirmed annually. The state grant covers 57 per cent of the average operating costs. However, the grant is not earmarked to be used for a particular purpose. For example, if a municipality is the local education provider, it receives a flat grant and it can freely allocate funds between schooling, social expenditure, health care and other tasks.

[3] For the Finnish speaking majority, the other national language is Swedish and compulsory foreign language most often English.

[4] Science and humanities exam includes questions from physics, chemistry, biology, religion, psychology and history, for example. Students can choose to answer questions from any subject area.

[5] Fraction of senior secondary school graduates in an age cohort is slightly higher than 50 per cent since some students enter senior secondary school at older age.

4. Data and variables

Our basic sample is a random sample of 89,000 people born in 1967–1981 from Employment Statistics (ES). This is a main labour market database of Statistics Finland with information on individual's income, employment status, education, and household composition etc. Data are based on about 30 different official registers. Currently ES cover the years 1987–1997. For our sample we merge additional information from the National joint application register and the Matriculation Examination Board register. We also add the information on the parents of the sampled individuals in the ES database.

Matriculation Examination Board register provided us with the matriculation examination grades. This register includes both grades and times of examinations. We use data for the years 1990–1998. We defined the year of matriculation examination to be the year when the student has taken all four compulsory exams (not necessarily passed). If the student has later supplemented his/her examination, we have added the new scores in the results, but if a student has attended again an exam that she has already passed or failed, we have used the score from the first attempt at this exam.

Achievement level of the students at the point when they enter senior secondary school can be found from the National joint application register. We had data from the years 1987–1998 with information on students' grade point averages in comprehensive school, the final year of the comprehensive school and the type of secondary education where the student applied and was accepted to. Starting year of the senior secondary school was also obtained from the applicant register. However, there was a large number of students who had completed matriculation examination, but who had no information on the starting year. In these cases, we coded the starting year as the year of the matriculation examination minus three.

We measure student's family background by parents' education, annual income and employment status using the ES data. Parents’ education is recorded at the time when the students enter secondary school. We converted the level of education into years of schooling using the mean years of schooling attached to the different levels of education. Parents’ income is an average over three years that students spend in the secondary school. We have also information on education level of the population at municipality-level and information on unemployment rate at the local labour market.

We have information on 444 senior secondary schools from 276 municipalities. Data cover only day schools; evening schools and special senior secondary schools were excluded. Data on the teaching expenditure for the years 1987–1992 originate from educational expenditure register collected by the National Board of Education. Data for years 1993–1997 are based on Statistics Finland

municipality databases[6]. The expenditures in the expenditure register are specified in great detail and the method of collecting the data has remained almost unchanged in 1987–1992. From the year 1993 onwards, the expenditures are specified in a much rougher level. In order to be able to compare both time periods, we describe the trends in expenditures according to the 1993–1997 classification.

Expenditures include information on the teaching expenditure, the operating costs and other costs both as absolute figures and as average costs per student. We deflated all cost variables to the 1997 prices. Wages, pension expenditure and social security payments are deflated using the wage and salary earnings index of the municipal workers. Other costs are deflated using the cost-of-living index.

In addition to educational expenditure, we had varying municipality level information on other school resources, for example, the number of lessons, the number of teachers and the number of students from the education expenditure register covering the years 1987–1997. We had school level information on the number of students and teachers, teachers' experience and the percentage of qualified teachers covering the years 1989–92. These data were obtained from the PELU-register held by the National Board of Education. The PELU-register has not been updated since 1992. We also had some additional school level information: school averages of matriculation examination grades, final report scores, parents' educational level, percentage of female students and the number of matriculation examinations completed in school. This school level information mainly covers the years 1989–1991, though some information was also available for the years 1992–1993. Most of this additional resource data is not used in this study.

The two data sets – the one including the students and the other including the schools – were merged by Statistics Finland. In order to prevent identifying individual students from the data, the identity of the schools was concealed in the merging process. From the 23,199 students whose scores we had collected from the Matriculation examination board register, we lost 1,879 observations due to missing data on these students' schools. After merging the data sets, we were left with information on about 21,320 students who had completed their examination between 1990 and 1998.

[6] If several senior secondary schools are located in the same municipality, the costs cannot be attributed to the individual schools, but they are municipality's schooling costs. Since most of the municipalities in Finland have only one senior secondary school, this is an issue that concerns mainly larger cities. School-specific cost information is available for private schools also in the cases where there are more than one senior secondary school in the same municipality.

5. Descriptive analysis

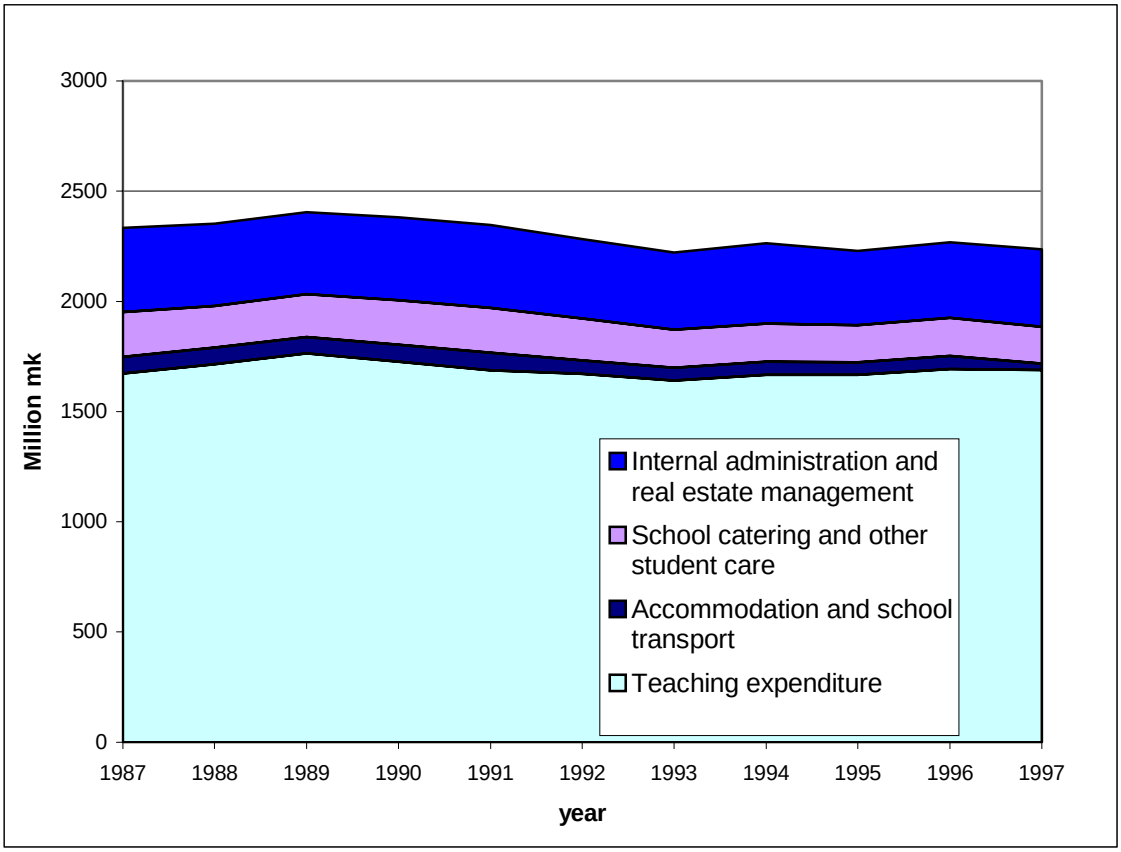
In this chapter we describe how school spending has changed during last ten years in the Finnish secondary schools. After that we have a look at the trends in student outcomes. The analysis on the impact of school spending on student outcomes follows in the next chapter.

5.1 Development in school resources

In 1997, total schooling expenditure in all senior secondary schools were approximately 2.3 billion marks. The total expenditure is divided into four cost categories: internal administration and real estate management, school's catering and student care, accommodation and school transport, and teaching expenditure. By far the largest category is the teaching expenditure, which comprises of teachers' salaries, teaching materials, teachers' training, and other teaching related costs. The teaching expenditure covers roughly 73 per cent of the total schooling expenditure.

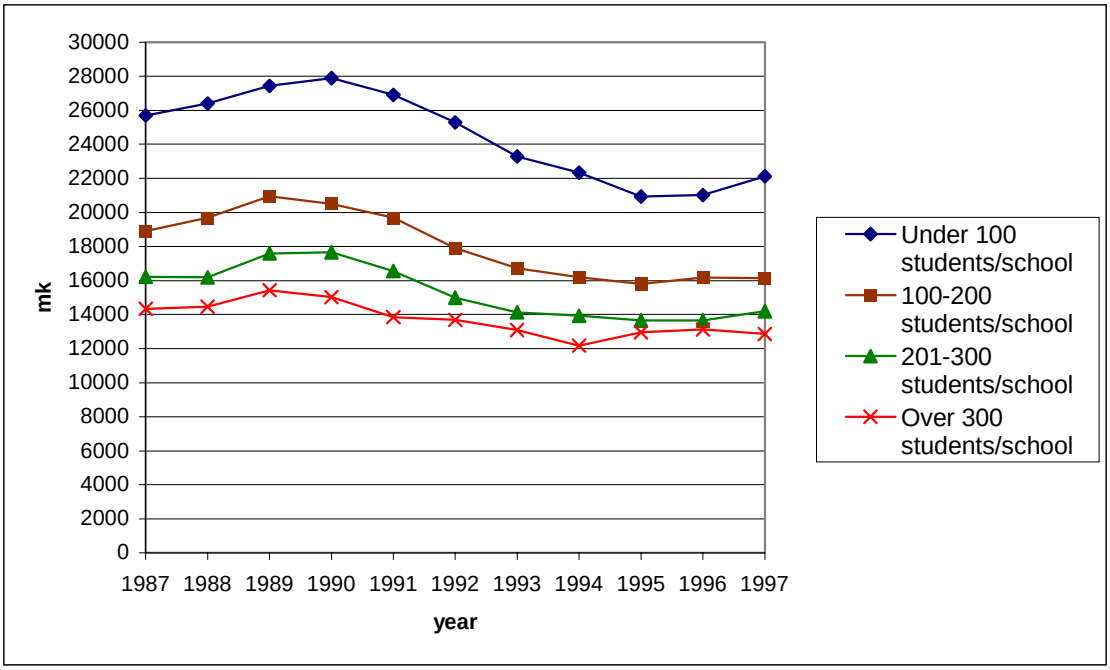
Total expenditure increased slightly in 1987–1989, but decreased by over 200 million marks in 1990–1993. Between 1994 and 1997, the total expenditure have again increased, but they are still at lower level than at the end of the 1980's. The percentage of teaching expenditure has grown steadily from 71 per cent in 1987 to 76 per cent in 1997. The share of accommodation and transportation has decreased from 1.6 per cent to 0.4 per cent and the share of school catering and other student care from 8.6 per cent to 7.0 per cent. It appears that when expenditures were cut, supplementary expenditure were cut by more, while teaching expenditure and internal administration and real estate management expenditure have not decreased as much.

Figure 1. *Total Expenditure (in millions, 1997 prices) in Senior Secondary Schools 1987-1997*



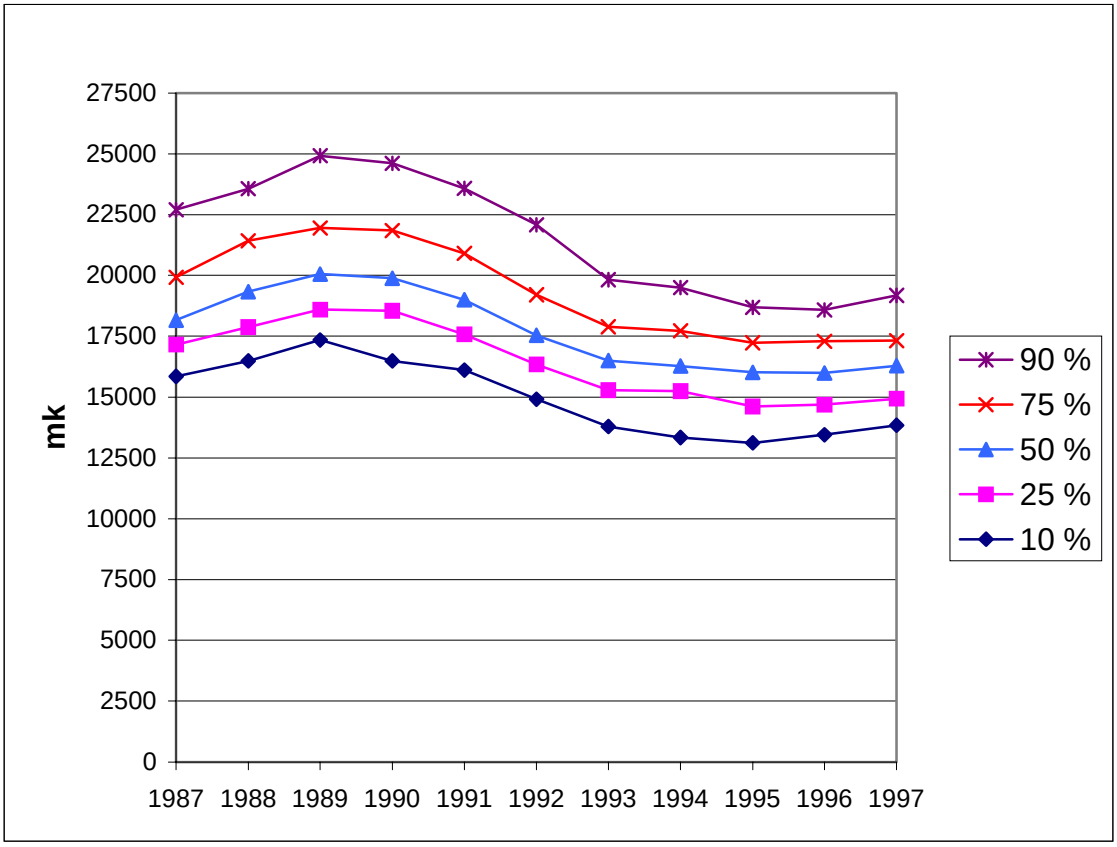
Teaching expenditure per student have developed quite similarly as the total teaching expenditure. The median teaching expenditure per student decreased by 30 per cent from 1990 to 1994. On average over the whole period, the teaching expenditure were about FIM 16,000 per student. In addition to the yearly variation, there is also significant variation in the teaching expenditure between schools. The most important factor explaining the between school variation is the size of the school. The schools with less than 100 students have considerably higher teaching costs per student than the other schools (Figure 2). However, also the decline in teaching expenditure per student has been largest in small schools.

Figure 2. *Median teaching expenditure per student by school size. Only private schools and municipalities with one senior secondary school are included.*



If the school size is controlled, the variation in teaching expenditure per student is much smaller. For Figure 3 we have adjusted the teaching expenditure for school size by regressing the teaching expenditure per student on the inverse of the number of students in school and the yearly dummies. Then we have subtracted the effect of school size from the expenditure and plotted the regression adjusted teaching expenditure (Figure 3).

Figure 3. Adjusted teaching expenditure per student (percentiles).



The teaching expenditure per student has been adjusted by regressing $\frac{Exp_t}{n_t} = a_0 + a_t D_t + b(\frac{1}{n_t} - \frac{\overline{1}}{n}) + \varepsilon_{it}$, where n is the number of students, t year, D_t the dummy variable for year t, $\overline{n}$ median of the number of students and ε is the residual. Adjusted teaching expenditure per student is $\frac{Exp_t}{n_t} = a_0 + a_t D_t + \varepsilon_{it}$

However, even after controlling for the differences due to the school size, there is still a considerable amount of variation in school spending across schools. The difference between the highest and the lowest decile is almost FIM 5,000. These differences are partly due to specialised programs in some schools (sports, music etc.) that receive an additional grant from the state. However, here we are interested in whether the differences in school spending are related to the financial situation of the local governments.

In Table 1 we regress the teaching expenditure per student on the local government tax revenue, the local unemployment rate, the average education level in the municipality and the municipality's gross margin from the financial statement. The equation also includes yearly dummies interacted with the number of stu-

dents in the municipality[7]. We estimate the model with random (municipality) effects panel regression.

Table 1. Teaching expenditure. Estimates from random effects regression.

Dependent variable: municipality's teaching expenditure / student	(1)	(2)
Tax revenue / inhabitant	**0.21**	**0.23**
	(0.08)	(0.09)
Local unemployment rate	**-55.55**	**-65.60**
	(24.42)	(24.12)
Municipality's educational level	**-20.14**	-3.28
	(8.44)	(8.66)
Municipality's gross margin	-	-0.07
		(0.07)
Number of observations	2 737	2 464
Number of municipalities	274	274
"Overall R2"	0.71	0.74
Sigma u	2 301	2 326
Sigma e	1 978	1 904
Rho	0.58	0.60

All models include year dummies interacted with the inverse of yearly number of students. Tax revenue per inhabitant, unemployment rate and municipality's gross margin are lagged by one year. Standard errors in parentheses.

The results in the first column of Table 1 show that the economic situation of the local governments matter for school spending. The municipalities that can collect higher tax revenue per inhabitant spend more per student and the municipalities that are in high unemployment areas considerably less.

In column 2, we added the local education level[8] and the municipality's gross margin to the equation. We expected that local education level might influence the priorities of the municipal council, and that higher education level might be related to higher spending, but found no such effect. Instead, higher education level appears to be related with lower school spending. We have no explanation for this finding. Also, municipality's gross margin (tax revenues + state subsidies – spending) had no impact on school spending. However, this variable is naturally highly correlated with tax revenue, when tax revenue was not included, gross margin had a strong positive effect on the school spending.

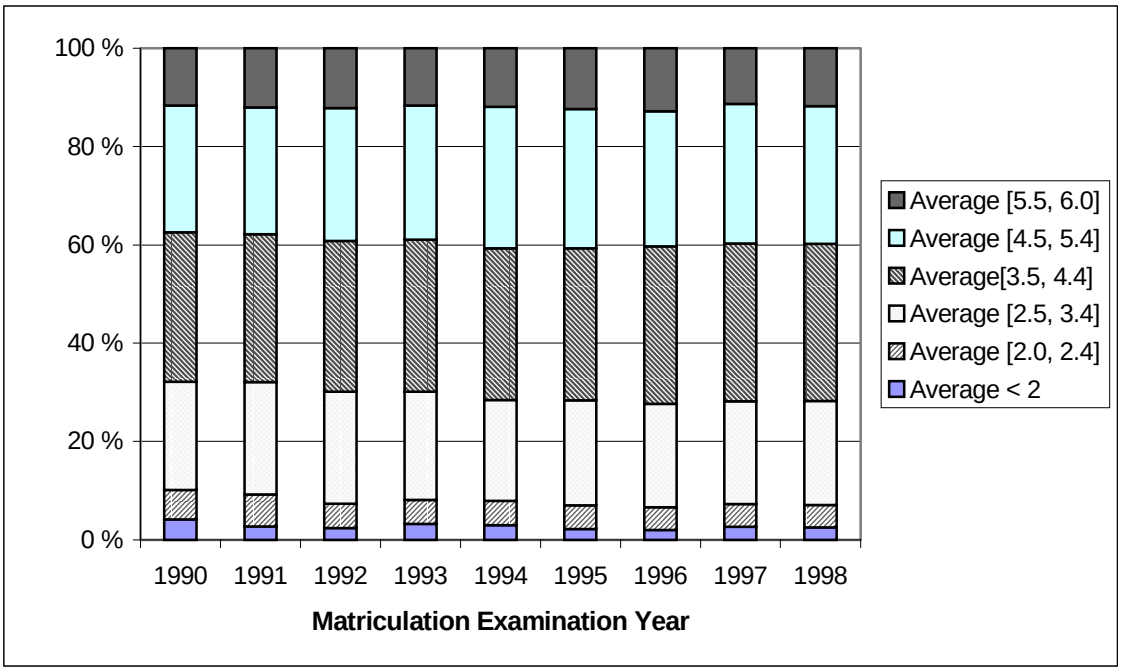
[7] Interacting yearly dummies with the inverse of the number of students allows for a different spending rule in each year. Since school subsidies are specified as marks per student and the amount per student varies across years, it seems natural not to restrict the effect of the number of students to be equal across the years.

[8] This is an index calculated by Statistics Finland based on the fraction of the population in the different education levels.

5.2 Trends in student performance

Assessing the trends in student performance is slightly difficult with matriculation examination data since the matriculation examination scores are standardised to yield the same distribution every year. The examination scores are a selection criteria to universities and the standardisation is done to ensure that the different student cohorts have an equal chance to be accepted to a university even if the matriculation exam has been more difficult in some year. Therefore, it is not surprising that there appear to be no trends in the outcome. About 10 per cent of the candidates reach excellent (5.5-6.0) average test scores each year[9]. Less than 5 per cent of the candidates fail the matriculation examination.

Figure 4. Matriculation examination grade point averages.

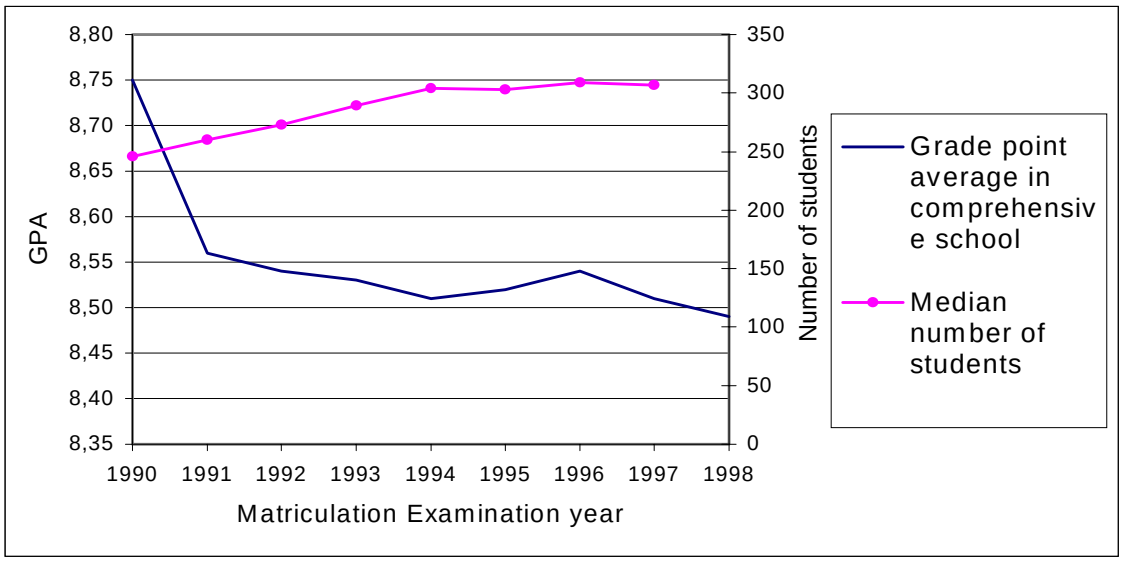


An additional difficulty in comparing the results across the years is that the number of students in senior secondary schools has increased over the years. The number of schools has remained almost constant but the median school size has increased by about 50 students in seven years. In 1997, the median number of students per school was about 300. As the number of slots in the school system increases, the admission gets less selective. As a consequence, the comprehen-

[9] Matriculation exam scores in each exam range from improbatur (failed) to laudatur (excellent). Scores are converted to a scale from 0 to 6. In 1996, laudatur was split into eximia cum laude approbatur and laudatur. To maintain comparability across years, we coded both eximia and laudatur as 6. The maximum score in six exams is, therefore, 36. The sample average in our data is 20.

sive school grade point averages of the new entrants have a negative time trend[10] (Figure 5).

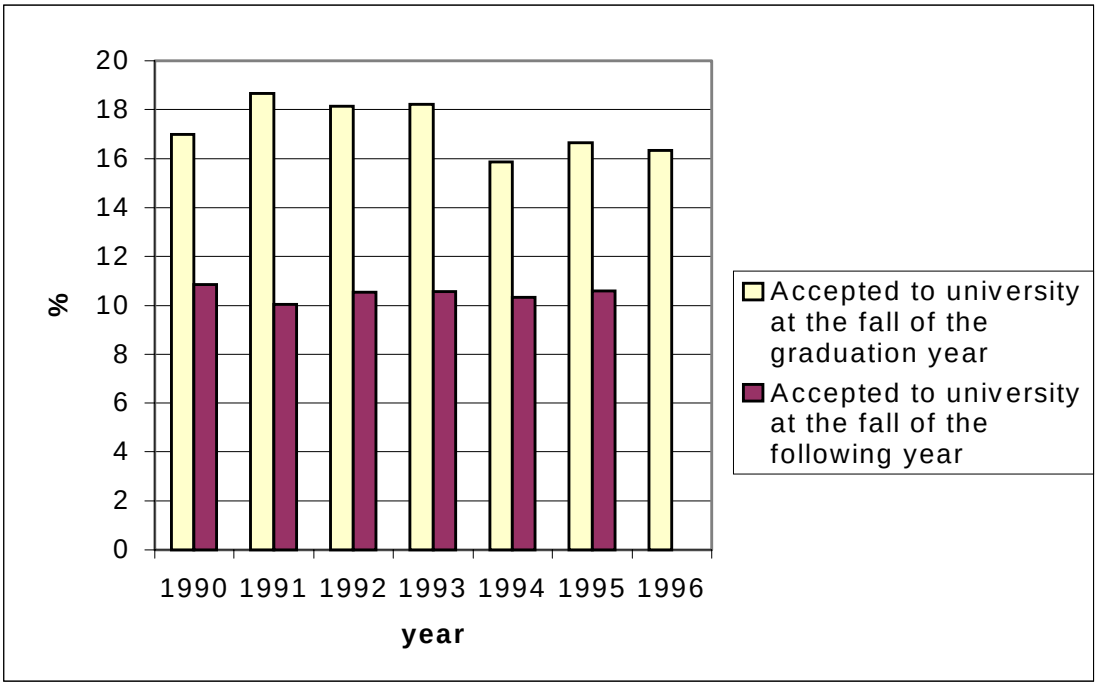
Figure 5. *Development in comprehensive school mean grade point averages of senior secondary school graduates and in median number of students in senior secondary schools.*



Comparing the matriculation examination scores is not the only possible way of evaluating school performance. Another widely used measure is the fraction of students that are accepted to universities. Figure 6 shows the fraction of students, who were accepted to universities in the fall of the matriculation examination year and in the fall of the following year. Approximately 16 per cent of senior secondary school graduates are accepted to universities immediately and 10 per cent of graduates get into a university in the following year. Even this is not a complete picture. The total number of university students has been growing throughout the 1990's, but a large fraction of the university students start their studies later than two years after the matriculation exam.

[10] The average comprehensive school GPA in the first year in our sample is a clear outlier. Students who took their matriculation examination in 1990 and entered senior secondary school in 1987 appear to have had on average 0.2 grades higher GPA. We suspect that this results from missing GPA information for class repeaters who entered senior secondary school already in 1986 (1987 was our first year of applicant register data).

Figure 6. *Fraction of students accepted to universities in the fall of the graduation year and in the fall of the following year.*



6. Results

The main question of this paper is whether the reduction in secondary school spending that occurred during the 1990's has had a negative impact on the matriculation examination results. However, there are at least two issues that make this analysis more complicated.

First, since the matriculation exam results are standardised across the years, there is no annual variation in the test scores. If the reduction in school spending had been equally large in all schools, annual variation in school spending could not be used to evaluate the effects of resources on performance. Second, although the effect of spending on performance can be, and often has been, calculated from a single cross-section, it is not clear that cross-section estimates reveal a causal relationship. A positive correlation between school spending and student performance can be due to unobserved differences in schools. For example, parents that are more concerned about their children may get their children into the better schools. Parental involvement may also have positive effect on learning, creating a correlation between school quality and achievement, even if school quality had no causal effect on learning. Although it is possible to control for the differences in the initial achievement level and the family background of the students, there is no way to be certain that the partial correlation between school resources and student achievement is a causal effect and not a spurious association.

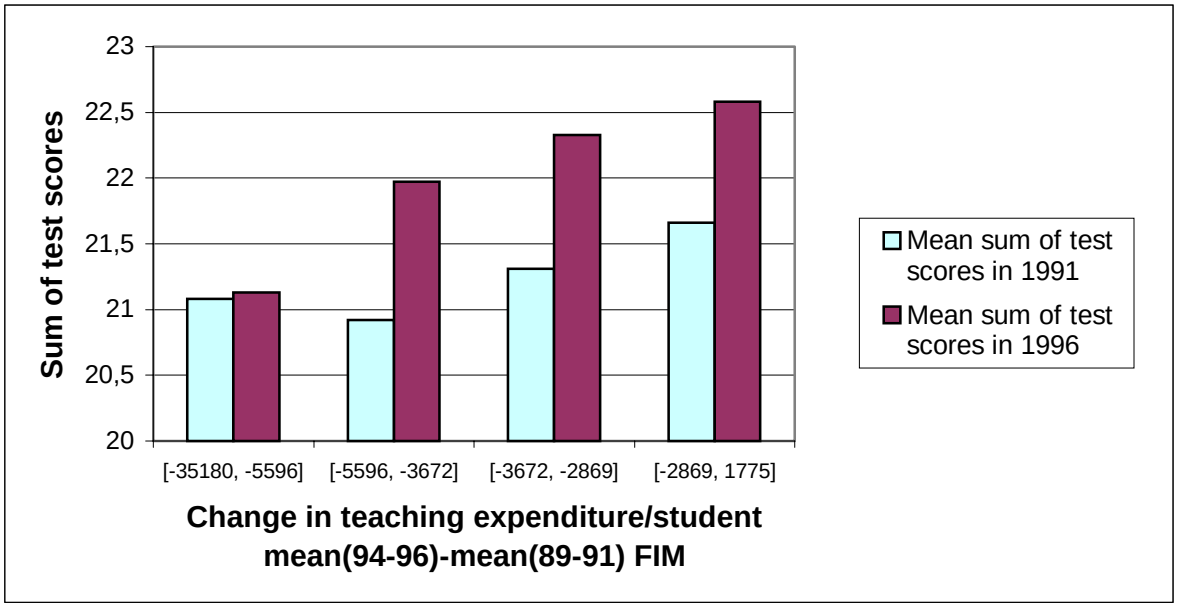
A common approach to identifying causal effects is to rely on instrumental variable (IV) estimates. In our case this would mean finding variables that affect the school spending but not the achievement of the students. The approach would utilise exogenous variation in school spending to create a natural experiment, and estimate the effects of school spending as in a randomised trial. However, even though we have potentially valid instruments available (municipality tax revenue) we chose to use the panel nature of our data to control for school specific time invariant factors. So instead of studying the effect of the level of school spending on the level of achievement, we study the effect of changes in spending on the changes in achievement.

As a preliminary demonstration of our approach, we divided schools into four equal sized groups based on the reduction in their per student teaching expenditure. The first group, therefore, consists of schools that reduced teaching expenditure per student between early and mid 1990's by more than FIM 5,600[11] and the last group of schools that reduced expenditure by less than FIM 2,700. As shown in Figure 7, the schools which reduced expenditure less had higher average sum of test scores (all exams included) both in 1991 and in 1996, but the dif-

[11] The schools where the reduction was most severe are mainly small schools located in Northern Finland. Six out of ten schools which saved most were from Lapland.

ference between the schools that saved less and the schools that saved more was larger in 1996. The schools that saved less were able to raise the average test scores of their students by approximately one unit (puoltoääni), while the schools that saved more had their average results almost unchanged.

Figure 7. Change in per student teaching expenditure and student performance in 1991 and 1996.



The comparison of the changes in the matriculation examination scores and the changes in the school spending can be improved by controlling for the changes in student composition and family background. Below we formulate a fixed effects panel estimator that controls for these explanatory factors. However, the basic idea is same as in Figure 7. The effects of school spending are evaluated by examining the effects of the changes in spending on the changes in test scores. The permanent differences between "good schools" and "bad schools" are eliminated in the fixed effects approach.

Our basic approach involves estimating value-added regressions explaining the matriculation exam score with the grade point average in the comprehensive school, measures of family background and school spending:

$$A_{ist} = \alpha + \beta\, R_{st} + \chi\, F_{ist} + \delta\, GPA_{ist} + u_s + \upsilon_t + \varepsilon_{ist}$$

where A is the matriculation exam score, R is a measure of school resources averaged over the three years that the student is in school, F is a vector of family background characteristics, and GPA is the grade point average in the comprehensive school. Index i refers to individual, s to school and t to time. We use two-

way fixed-effect panel estimator[12]. Therefore, u_s is a fixed school effect, υ_t a fixed time effect[13], and ε_{ist} a random error term.

In the fixed effect framework, the effect of variables that vary across students in the same school (for example GPA) is identified from the variation between students in the same school. Identification of the school specific variables is based on the within school variation over time i.e. differences in changes of resources between schools. Permanent differences in the school-specific characteristics are eliminated with school fixed effects.

Table 2 presents the estimation results of the fixed effect model. The data cover years 1990–1998. The dependent variable is a sum of test scores in six exams[14]. First in column one we use data from all the 444 senior secondary schools.

As expected, the grade point average in comprehensive school has a very large effect on the matriculation examination results. A unit increase in GPA[15] increases the matriculation exam score by almost eight points, which is equivalent to an increase of score in each exam by more than one point. Also parents' education has a strong effect on the matriculation examination score even when the comprehensive school GPA is controlled for. Boys do slightly better than girls.

Our principal measure of school resources is teaching expenditure per student as an average over three years[16]. This consists of teachers salaries and teaching equipment. We consider teaching expenditure a summary measure of class size, teaching hours and teachers' experience. In addition, it is the main policy instrument of local governments.

However, the results show no effects of teaching expenditure on student performance. The estimates are positive but insignificantly different from zero. It should be noted that the effect is rather precisely estimated. An increase of teaching expenditure per student by FIM 1,000 (5 per cent increase) is estimated to increase the matriculation examination scores by between -0.04 and 0.08 points.

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[12] We estimated the equations also using a random-effect estimator, with the school random effects. The results were not sensitive to the specification.

[13] The matriculation exam scores are standardised to have the same distribution each year, but differences in explanatory variables cause the time effects to be significant. For example, there is a negative time trend in the average GPA of students entering senior secondary school.

[14] Matriculation exam scores in each exam range from improbatur (failed) to laudatur (excellent). Scores are converted to a scale from 1 to 6. The maximum score in six exams is, therefore, 36. The sample average is 20.

[15] Grading in comprehensive school is done on the scale from 4 (fail) to 10. Some senior secondary schools accept all applicants regardless of their GPA, and to some schools the minimum entrance requirement is GPA over 9. Average GPA in our sample is 8.5.

[16] We also estimated models using teaching expenditure from different years separately, but it did not matter which way the teaching expenditure were specified.

Table 2. *Estimation results. Dependent variable is sum of test scores in six exams (mother tongue, the other national language, mathematics, compulsory foreign language, additional foreign language, science and humanities).*

Dependent variable: Sum of test scores in six exams	(1)	(2)	(3)	(4)
Comprehensive school GPA	**7.89** **(0.06)**	**7.90** **(0.06)**	**7.90** **(0.09)**	**7.91** **(0.09)**
Mother's education	**0.32** **(0.02)**	**0.32** **(0.02)**	**0.31** **(0.03)**	**0.30** **(0.03)**
Father's education	**0.19** **(0.01)**	**0.19** **(0.01)**	**0.18** **(0.02)**	**0.18** **(0.02)**
Teaching exp./student (in thousands)	0.02 (0.03)	0.02 (0.03)	0.02 (0.04)	0.005 (0.04)
Male	**0.15** **(0.07)**	**0.16** **(0.07)**	-0.08 (0.11)	-0.07 (0.11)
Work during senior secondary school	-	**-0.62** **(0.10)**	-	**-0.52** **(0.14)**
Unemployment rate	-	-0.02 (0.02)	-	0.006 (0.03)
Number of students in school	-	-0.0002 (0.0002)	-	**-0.003** **(0.001)**
Sigma u Sigma e Rho	1.65 4.88 0.10	1.68 4.87 0.11	1.66 4.88 0.10	1.72 4.87 0.11
"Overall R2"	0.485	0.482	0.489	0.483
Number of observations	20 508	20 507	9 443	9 443
Number of schools	444	444	245	245

Standard errors in parenthesis. Models (3) and (4): only private schools and municipalities with one school included. Work during senior secondary school is a dummy variable indicating that the student worked during the school year (1 if work months >2, 0 otherwise). All models include year dummies and school fixed effects.

In column 2, we add local unemployment rate, school size and a dummy variable that indicates whether the student has been working during the school year[17]. The school size and local unemployment rate have no effect. Working during the school year appears to decrease the exam scores. However, adding these variables has no impact on the coefficients of teaching expenditure, family back-

[17] Work during the school year is defined based on the months worked in the ES data. We assume that if a student has worked for more than two months, she must have been working, not only during the summer holidays, but also during the school year.

ground or GPA. Also the model fit does not improve. Altogether, the variables in the model explain little less than half of the variance in the matriculation examination scores. About 10 percent of the remaining variance is attributed to between school variation.

As noted before, it is not possible to divide teaching expenditure between different schools in the same municipality. Therefore, in columns 3 and 4 of Table 2, we repeated the analysis using only private schools and the municipalities with only one senior secondary school. The results on this smaller sample are similar to the estimates including all schools. The only differences are that the coefficient of the school size decreases and appears to be significant and that boys are not performing better any more.

The minimum requirement in the matriculation examination is passing four exams. Evaluating student performance according to the sum of scores in six exams, therefore, accounts for both the number of exams taken and the success in these exams. It can be argued that this is exactly what the evaluation should be based on. For example, good performance in a voluntary exam in foreign languages should probably be counted as an important output of schools. On the other hand, it may be reasonable to focus on the part of the exam that all students attend to. In Table 3, the equations in Table 2 are re-estimated using the average score in compulsory exams[18] as the dependent variable.

Accounting for the different scaling, the results in Table 3 are not much different from the results in Table 2. Comprehensive school GPA and parents' education still have a strong effect. Because girls are more likely to take an extra language exam, boys perform relatively better when measured with the average test score; in Table 3 the difference between boys and girls is larger than in Table 2. The coefficients of the local unemployment rate, work during school year or school size are robust for the different specification of the dependent variable.

Teaching expenditure per student do not have any effect on the average of compulsory examinations, either. The coefficient actually turns negative, but the estimate is very close to zero.

[18] Students may choose either math or science and humanities exam as one of the four compulsory exams. However, we were not able to tell which one was the compulsory exam, if the student had taken both exams. Therefore the variable is actually a mean of test scores in four or five exams, depending on the number of exams the student has taken.

Table 3. *Estimation results. Dependent variable is mean of test scores in five tests (mother tongue, the other national language, compulsory foreign language, mathematics and/or science and humanities).*

Dependent variable: Mean of test scores in compulsory exams	(1)	(2)	(3)	(4)
Comprehensive school GPA	**1.15** **(0.01)**	**1.15** **(0.01)**	**1.17** **(0.02)**	**1.17** **(0.02)**
Mother's education	**0.05** **(0.003)**	**0.05** **(0.003)**	**0.05** **(0.005)**	**0.05** **(0.005)**
Father's education	**0.03** **(0.002)**	**0.03** **(0.002)**	**0.03** **(0.004)**	**0.03** **(0.004)**
Teaching exp./student (in thousands)	-0.0019 (0.005)	-0.0018 (0.005)	-0.0006 (0.006)	-0.003 (0.006)
Male	**0.05** **(0.01)**	**0.05** **(0.01)**	0.03 (0.02)	**0.04** **(0.02)**
Work during senior secondary school	-	**-0.11** **(0.02)**	-	**-0.10** **(0.02)**
Unemployment rate	-	-0.002 (0.003)	-	0.002 (0.005)
Number of students in school	-	-0.00002 (0.00003)	-	**-0.0005** **(0.0002)**
Sigma u Sigma e Rho	0.23 0.81 0.08	0.24 0.81 0.08	0.24 0.80 0.08	0.25 0.80 0.09
"Overall R2"	0.430	0.427	0.441	0.435
Number of observations	20 508	20 507	9 443	9 443
Number of schools	444	444	245	245

Standard errors in parenthesis. Models (3) and (4): only private schools and municipalities with one school included. Work during senior secondary school is a dummy variable (1 if work months >2, 0 otherwise). All models include year dummies and school fixed effects.

We suspected that school resources might have different impacts on “good” and “poor” students. It could be argued that poor students suffer more in large classes while larger class size has little effect on good students. Ordinary least squares regression model evaluates the effect of the explanatory variables on the conditional mean of the dependent variable. However, it is also possible to estimate the effects of the explanatory variables on the median, or other percentiles of the distribution of the dependent variable using quantile regression. It is possible that a variable has no effect on the mean, but a positive or negative effect at the tails of distribution. As a concrete example, consider the effect of remedial instruction directed to students who have trouble keeping up with their class. It is likely that

such extra teaching has more effects on a poor student than on an average student.

To test whether the effects of school resources are different at different points of the distribution, we estimated 0.1, 0.25, 0.5, 0.75 and 0.9 quantile regressions to see if teaching expenditure or other variables have different effects on matriculation examination results in different levels of achievement. However, the hypothesis gains little support from the data. For some reason teaching expenditure per student seem to have a negative effect on student performance, but the coefficient is very small and non-significant for those in the lowest quantile (Table 4). Mother's education has a greater (positive) effect on students at lower achievement level than at higher achievement level.

Table 4. Quantile regression results.

Dep. var.: mean of test scores in compulsory exams	0.1	0.25	0.5	0.75	0.9
Comprehensive school GPA	**1.30** (0.02)	**1.26** (0.02)	**1.21** (0.01)	**1.06** (0.01)	**0.88** (0.01)
Mother's education	**0.07** (0.005)	**0.06** (0.005)	**0.05** (0.004)	**0.04** (0.004)	**0.03** (0.004)
Father's education	**0.03** (0.004)	**0.04** (0.004)	**0.03** (0.003)	**0.03** (0.003)	**0.03** (0.003)
Teaching exp./student (in thousands)	-0.006 (0.003)	**-0.007** (0.003)	-0.004 (0.002)	-0.004 (0.002)	-0.004 (0.002)
Number of students in school	-0.000006 (0.000006)	0.000001 (0.000004)	**0.00001** (0.000004)	**0.00001** (0.000004)	**0.00001** (0.000002)
Male	0.003 (0.02)	**0.05** (0.02)	**0.09** (0.02)	**0.06** (0.02)	0.02 (0.01)
Pseudo R2	0.235	0.257	0.274	0.262	0.218
Number of students	20 508				

Standard errors in parentheses.

Also classmates may have an effect on student performance. Students in classes where other students perform well, may score better in matriculation exams. We tested the idea by re-estimating the model in Table 2, but adding the average score of the other students in class to the equation[19]. The results indicate that classmates average score does increase the performance in the exam. The point estimates indicate rather large effects that are robust across different specifica-

[19] To be exact this is the mean matriculation exam score of other students in the same school that completed the matriculation exam in the same year. In most schools there are more than one graduating class so these students do not necessarily sit in the same classroom. On the other hand, the classes in the senior secondary are not defined very clearly, students study different subjects with different classmates.

tions. However, it is not clear that these estimates can be interpreted as peer effects (See Manski 1993). A positive correlation between the exam scores within students in the same class may also be caused by unobservable factors, for example, teacher quality. (The students in the same class are taught by the same teachers). Adding the average score of the students in the same class also removes the random school effect. In fact, the random school effect also captures the similarity of the students in the same class, much like adding the average score of the other students in the class.

Table 5. *Random effects regression. Dependent variable is sum of test scores in six exams (mother tongue, the other national language, mathematics, compulsory foreign language, additional foreign language, science and humanities).*

Dependent variable: sum of test scores in six exams	(1)	(2)	(3)	(4)
Comprehensive school GPA	**7.71** (0.06)	**7.74** (0.06)	**7.81** (0.09)	**7.82** (0.09)
Classmates' mean sum of test scores in matriculation exam	**0.12** (0.01)	**0.12** (0.01)	**0.10** (0.01)	**0.10** (0.01)
Mother's education	**0.34** (0.02)	**0.33** (0.02)	**0.33** (0.03)	**0.32** (0.03)
Father's education	**0.20** (0.01)	**0.20** (0.01)	**0.18** (0.02)	**0.18** (0.02)
Teaching exp./student (in thousands)	0.005 (0.01)	0.008 (0.01)	-0.006 (0.01)	-0.01 (0.02)
Male	**0.13** (0.07)	0.12 (0.07)	-0.10 (0.11)	-0.10 (0.11)
Work during senior secondary school	-	**-0.58** (0.10)	-	**-0.47** (0.15)
Unemployment rate	-	**-0.08** (0.01)	-	**-0.05** (0.01)
Number of students in school	-	**-0.0001** (0.00002)	-	**-0.0008** (0.0003)
Sigma u Sigma e Rho	0 4.88 0	0 4.87 0	0 4.88 0	0 4.88 0
"Overall R2"	0.49	0.49	0.49	0.49
Number of observations	20 210	20 209	9 195	9 195
Number of schools	443	443	244	244

Standard errors in parenthesis. Models (3) and (4): only private schools and municipalities with one school included. Work during senior secondary school is a dummy variable indicating that the student worked during the school year (1 if work months >2, 0 otherwise). All models include year dummies.

Although the teaching expenditure did not have any effect on the average or sum of matriculation examination test scores, it may have an impact on sub scores of the examination. If a school needs to cut spending, it is not likely to cut spending

on the “core” courses but rather to decrease spending on supplementary voluntary courses. A prime candidate is spending on the additional voluntary language courses that are typically taught in rather small classes.

We tested the idea by estimating a Tobit-model using test score in voluntary language test as the dependent variable. The Tobit-model accounts for both the likelihood that students take the voluntary language test and the performance in the test. The results of the Tobit-model are in Table 6. As before, the comprehensive school GPA and parents’ education are the strongest predictors of the performance in the language tests. However, also teaching expenditure per student appear to have a positive and statistically significant effect. Although it is probably wise not to make too much of a single significant coefficient, we should note that when we estimated similar equations for the other subject tests, we found no significant effects. So even if cuts in the school spending do not seem to have had a very large effect on the average performance of Finnish secondary school students, it is possible that cuts in spending have had a deteriorating impact on language skills.

Table 6. Additional language test. Tobit estimates.

Dependent variable: Test score in additional language exam	(1)
Comprehensive school GPA	**2.78**
	(0.06)
Mother's education	**0.17**
	(0.02)
Father's education	**0.06**
	(0.01)
Teaching exp./student	**0.03**
(in thousands)	(0.01)
Number of students	**-0.00008**
	(0.00002)
Male	**-2.38**
	(0.07)
Work during senior secondary	**-0.20**
school	(0.09)
Urban area	0.04
	(0.08)
Unemployment rate	**-0.09**
	(0.01)
Number of observations	20 507
(uncensored observations)	(9 192)
Pseudo R2	0.07
Log-likelihood	-32 658

Standard errors in parentheses.

While not directly related to the main question on the impact of school resources on student achievement, the data allow to examine other interesting issues. Below, we have a look at the factors that influence the entry to senior secondary school and the factors that influence entry to university after secondary school. Entry implies that students have applied and been accepted. It is not possible to separate the factors that influence applications from the factors influencing acceptance.

Table 7 presents the probit-estimates of entering the senior secondary school. Unsurprisingly, we find that parents' education and comprehensive school GPA are the strongest predictors of secondary school attendance. Somewhat more surprising is the result that boys are 5 per cent more likely to enter secondary school when grade point average is controlled for. It is also found that the regional unemployment rate lowers the probability of entering senior secondary school and that the entry probability is about 3 per cent higher in the urban areas. As shown in Table 8, the model does a reasonably good job in predicting secondary school entry as 76 per cent of predictions are correct.

Table 7. *Senior secondary school acceptance 1988-1998. Estimates are marginal effects at means of the regressors, except for dummy variables (*) marginal effects are for discrete change from 0 to 1.*

Dependent var.: accepted to senior secondary school	(1)	(2)	(3)
Comprehensive school GPA	**0.56** **(0.004)**	**0.56** **(0.004)**	**0.56** **(0.004)**
Mother's education	**0.04** **(0.002)**	**0.04** **(0.002)**	**0.04** **(0.002)**
Father's education	**0.04** **(0.001)**	**0.04** **(0.001)**	**0.04** **(0.001)**
Male *	**0.04** **(0.005)**	**0.05** **(0.006)**	**0.05** **(0.006)**
Regional unemployment rate	-	**-0.002** **(0.0007)**	**-0.001** **(0.0007)**
Urban area * [1]	-	-	**0.03** **(0.006)**
Pseudo R2	0.430	0.436	0.436
Number of observations	64 896	57 747	57 747
Observed probability Predicted probability (at x-bar)	0.500 0.498	0.506 0.509	0.506 0.509

All models include year dummies. [1] Countryside is the reference group.

Table 8. Cross tabulation of predicted and observed frequencies of senior secondary school entry.

	Person didn't go to senior secondary school	Person went to senior secondary school	Total
Person wasn't predicted to go to senior secondary school	23 243	5 079	28 322
Person was predicted to go to senior secondary school	10 654	27 507	38 161
Total	33 897	32 586	66 483

Finally, in Table 9 we estimate probit-models that explain whether the student is enrolled at a university in the fall of the matriculation examination year. University entry is highly competitive in Finland and only less than 20 percent of the senior secondary school graduates enter university in their graduation year[20].

The results on university entry in Table 9 resemble the results on entry to secondary school. Naturally, scholastic achievement whether measured as sum of test scores in six exams or as mean of test scores in compulsory exams has a strong effect on the probability of being enrolled in a university. More surprisingly also comprehensive school GPA has a strong positive effect on university entry. We suspect that this is due to matriculation exam score being an imperfect measure of the students true ability level, and that comprehensive school GPA picks up some of this ability effect[21].

Controlling for the examination results, men are approximately 5 per cent more likely to enter university. Also, parents' education has a positive effect on the university entrance. An extra year of education for either parent is associated with a 0.2 per cent increase in the probability of entering university. All else equal, a student whose both parents have a university degree is almost 5 per cent more likely to enter a university than a student whose both parents have only basic education. We also find that students from the high unemployment areas are less likely, but students from rural areas are more likely to enter university.

[20] Another ten percent enter year later. The qualitative results did not change when we performed the estimations using enrolment in the fall of the year after the matriculation examination year.

[21] University acceptance is based on the matriculation examination and the entrance exams. Weighting of the two examinations varies across universities and faculties.

Table 9. *University student at the fall of matriculation examination year. Estimates are marginal effects at means of the regressors, except for dummy variables (*) marginal effects are for discrete change from 0 to 1.*

Dependent variable: university student	(1)	(2)	(3)	(4)
Mean of test scores in five tests in matriculation exam	**0.06** **(0.002)**	-	**0.08** **(0.002)**	-
Sum of test scores in six tests in matriculation exam	-	**0.01** **(0.0003)**	-	**0.01** **(0.0004)**
Comprehensive school GPA	**0.07** **(0.003)**	**0.07** **(0.004)**	**0.07** **(0.004)**	**0.08** **(0.004)**
Male *	**0.05** **(0.003)**	**0.06** **(0.004)**	**0.06** **(0.004)**	**0.07** **(0.004)**
Mother's education	**0.002** **(0.0006)**	**0.003** **(0.0007)**	**0.003** **(0.0007)**	**0.003** **(0.0008)**
Father's education	**0.002** **(0.0005)**	**0.003** **(0.0005)**	**0.003** **(0.0006)**	**0.003** **(0.0007)**
Regional unemployment rate	-	-	**-0.005** **(0.0004)**	**-0.006** **(0.0004)**
Urban area [1]	-	-	**-0.02** **(0.004)**	**-0.02** **(0.005)**
Pseudo R2	0.318	0.307	0.319	0.307
Number of observations	21 872	21 872	19 182	19 223
Observed probability Predicted probability (at x-bar)	0.131 0.049	0.131 0.054	0.131 0.060	0.131 0.067

All models include year dummies. [1] Countryside is the reference group.

7. Conclusion

Our purpose was to examine the effects of school resources on student achievement with individual level data from years 1990-1998. We had a representative sample of the senior secondary school students, information on their background, past school performance and matriculation examination results. In addition, we had school resource variables attached to each student. Because of the 1993 school finance reform, we expected to observe variation in school spending across municipalities and examined whether these differences have had an impact on matriculation examination scores.

We estimated fixed effect panel regression models explaining the matriculation examination score with the grade point average in comprehensive school, parents' education, student's sex, local unemployment rate, a dummy variable indicating whether the student has been working during the school year, school size, and school's teaching expenditure. Matriculation examination score was defined either as a sum of test scores in six exams or as a mean of test scores in the compulsory exams. The definition had little effect on the results.

The grade point average in comprehensive school has a very large effect on the matriculation examination results. Also parents' education has a strong effect on the matriculation exam score, even when the comprehensive school GPA is controlled for. Teaching expenditure had no significant effect on the student achievement, whether the dependent variable was the sum of test scores or the mean. When using the sum of test scores, the estimates are positive but insignificantly different from zero. The mean of test scores results in negative but insignificant point estimates. Both estimates are very close to zero. Boys perform slightly better than girls and the difference is greater when measured with the average test score.

Although the teaching expenditure did not have any effect on the average or sum of matriculation examination test scores, it had an impact on achievement in additional foreign language exam in estimated Tobit-model. The Tobit-model accounts both for the likelihood that students take the voluntary language test and for the performance in the test. As before, the comprehensive school GPA and parents' education are the strongest predictors of the performance in the language exams, but also teaching expenditure per student appear to have a positive and a statistically significant effect. When we estimated similar equations for the other subject exams, we found no significant effects. So even if cuts in the school spending do not seem to have had a very large effect on the average performance of Finnish secondary school students, it is possible that cuts in spending have had a deteriorating impact on the language skills of the Finnish senior secondary school graduates.

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