Economic Studies 83

Iida Häkkinen

Essays on School Resources, Academic Achievement and Student Employment

Iida Häkkinen

Essays on School Resources, Academic Achievement and Student Employment

UPPSALA UNIVERSITET

Department of Economics, Uppsala University

Visiting address: Kyrkogårdsgatan 10, Uppsala, Sweden
Postal address: Box 513, SE-751 20 Uppsala, Sweden
Telephone: +46 18 471 11 06
Telefax: +46 18 471 14 78
Internet: http://www.nek.uu.se/

ECONOMICS AT UPPSALA UNIVERSITY

The Department of Economics at Uppsala University has a long history. The first chair in Economics in the Nordic countries was instituted at Uppsala University in 1741.

The main focus of research at the department has varied over the years but has typically been oriented towards policy-relevant applied economics, including both theoretical and empirical studies. The currently most active areas of research can be grouped into six categories:

- Labour economics
- Public economics
- Macroeconomics
- Microeconometrics
- Environmental economics
- Housing and urban economics

Additional information about research in progress and published reports is given in our project catalogue. The catalogue can be ordered directly from the Department of Economics.

ISBN 91-87268-90-6
ISSN 0283-7668

Doctoral dissertation presented to the Faculty of Social Sciences 2004

Abstract

HÄKKINEN, Iida, 2004, Essays on School Resources, Academic Achievement and Student Employment; Department of Economics, Uppsala University, *Economic Studies 83*, 123 pp, ISBN 91-87268-90-6.

This thesis consists of four self-contained essays.

Essay 1 (with Tanja Kirjavainen and Roope Uusitalo) analyzes the effects of changes in school spending on changes in student performance. We use a large sample of matriculation examination scores of Finnish senior secondary school students from the years 1990–1998. We estimate fixed-effect panel data models that use the dramatic changes in the school spending caused by the 1990s' recession as identifying variation. According to the results, changes in teaching expenditure did not have a significant effect on the test scores. The grade point average in comprehensive school and the parents' education are the strongest explanatory variables for student achievement.

Essay 2 examines which factors predict academic performance at university and compares the predictive values of subject-related entrance exams and indicators of past school performance. The results show that a large fraction of students would be admitted whether the admission was based on entrance exams, past performance or a combination of these, which is the current system. In the fields of engineering, social sciences and sport sciences entrance exams predict both graduation and the number of study credits after four years better than past school performance. In education past school performance is a better predictor of graduation. Changing the admission rule to school grades would affect the average student performance negatively in engineering and social sciences but positively in education. Using only entrance exams would not significantly change the average student performance in any field.

Essay 3 (with Roope Uusitalo) evaluates the changes in the times-to-degree at the Finnish universities in the 1990s. In particular, the study evaluates the effect of the 1992 student aid reform that was intended to shorten the duration of university studies. We find that the student aid reform had only a modest effect, and that this effect was limited to the fields with long median durations. Most of the decline in the observed times-to-degree can be explained by an increase in the unemployment rate that reduced student employment opportunities.

Essay 4 examines how university students' employment decisions affect their labor market success after graduation. The study is based on individual level panel data of Finnish university students from the years 1987–1998. The OLS estimates show that in-school work experience is associated with higher earnings and employment after graduation. Local unemployment rate during enrollment is used as an instrument for endogenous work experience acquisition. Comparing graduates with equal times-to-degree, the IV estimates show that work experience increases earnings considerably one year after graduation. The effect is smaller and statistically insignificant in later years. Taking into account that working usually leads to longer times-to-degree, IV estimates show no significant returns to student employment.

Contents

Acknowledgements

Writing a thesis is a long and unpredictable journey. When I started my PhD studies in Helsinki in the fall of 2000 I had no idea what I was getting myself into. Fortunately, I have got help and support from numerous people along the journey. First of all, I would like to thank my advisor and coauthor Roope Uusitalo for encouraging me to pursue PhD studies and for his excellent guidance throughout the time that it has taken me to write this thesis. His ideas and comments have been highly valuable. I also thank my other advisor, professor Per-Anders Edin, for inviting me to Uppsala and for all the comments and suggestions that have improved this thesis remarkably.

Several others have contributed to this thesis. The discussants on different parts of the thesis, professor Mårten Palme and Björn Öckert, provided a number of excellent suggestions that undoubtedly improved the quality of the thesis. Tanja Kirjavainen, who is also my co-author, was a big help in everything that has to do with school financing. Professor Heikki Loikkanen provided me with support and ideas at the early stages of my research. Oskar Nordström Skans has helped by discussing, reading and commenting on parts of the thesis. Thank you all!

The first year and a half of my PhD studies I worked at the Government Institute for Economic Research (VATT) in Helsinki. It is impossible to do empirical research without good data and I am grateful to VATT for giving me the opportunity to use their excellent data sets. I thank my friends and colleagues at VATT, especially Ossi Korkeamäki, Tomi Kyyrä, Veli Laine, Antti Moisio and Juha Tuomala, for the constructive discussions, help with my data problems – and of course – coffee breaks and everything else that made my life a bit more fun when I got frustrated with my research.

I am grateful to my fellow PhD students and other research staff at the Department of Economics in Uppsala for making my life more enjoyable during my stay. A special thanks to Åsa Ahlin, Mikael Carlsson, Daniel Hallberg, Karin Edmark, Erica Ericson, Stefan Eriksson, Patrik Hesselius, Jonas Lagerström, Viktoria Liss, Ruth-Aïda Nahum, Martin Söder-

ström, Andreas Westermark, and Pär Österholm. Sharing an office with Henrik Jordahl and later with Hanna Ågren has been a joy. Hanna has shared the moments of despair and happiness with me and she has been a good friend at the times when I have needed it. Thanks! I also thank Tuulia Hakola and Laura Larsson, my Finnish backups in Uppsala, for not only discussing economics with me but also sharing my interest in aerobics and working out with me.

I am grateful to the administrative staff at the Department of Economics in Uppsala. In particular, I would like to thank Åke Qvarfort for helping me with computer problems, and Eva Holst for all the help with the practical details. Financial support from Yrjö Jahnsson foundation and Finnish Cultural Foundation is gratefully acknowledged. I am also grateful for the support from the Research Training Network "New Techniques for the Evaluation of European Labour Market Policies", funded by the European Commission.

Sometimes you just have to forget about economics and a large number of non-economist friends all around the world have done a great job in helping me to do that. Thank you all! Singing in SOL has been the greatest distraction from work and I have enjoyed all the singing, laughs, tours and partys that we have had together. A big hug to all of you!

I would never have been able to complete this thesis without the love and support from my family. My mother and father have always backed me up whatever I have decided to do. It has also been a relief to know that I am always welcome home if I need a break from work. I am grateful to my sister and my brother and his family for everything they have done for me over the years.

Finally, I want to express my love and gratitude to Oskar. Your love, cheerfulness, and encouragement mean a world to me.

Uppsala, July 2004

Iida Häkkinen

Introduction

Economics of education has become a popular research topic in the recent years. Questions of economic efficiency of the schooling system interest not only researchers but also politicians, and education is one of the central topics in the public policy debate.

The society invests huge amounts of money in education. What individuals learn in education and what is the return to completing education are at least as important questions as the costs of education. Public investments in education improve the equality in the society. For example, an adequate grant-based student aid system increases the access to higher education for individuals with lower income. It is also known that without government subsidies individuals might invest less in education than what is socially optimal because there are positive externalities from education.[1] An educated workforce is important for growth and highly educated workers have a lower risk to become unemployed. Education is also positively linked to health (e.g., Lleras-Muney, 2002) and since health care is publicly provided, education expenditure might reduce the health care expenditure. The costs of education should therefore be seen in a context of returns for the individuals as well as for the society. However, evaluating the education system is important to make sure that it is working efficiently.

The economic efficiency of the schooling system is a particularly hot topic in Finland, where the whole education system is largely publicly funded. This thesis consists of four self-contained essays that analyze school resources, academic achievement, and student employment in Finland in the 1990s. In the following, I will introduce the different topics of the thesis and describe shortly the important reforms and the economic situation in the 1990s that have affected education expenditure and student employment in Finland.

The 1990s was a turbulent decade in the Finnish economy. At the beginning of the 1990s, Finland faced a severe recession. Unemployment rates increased from 3 to 18 percent be-

[1] See Björklund et al. (2004) for more discussion on the externalities from education.

tween 1991 and 1994 and the unemployment rate for 15–24 -year-olds was over 30 percent for three years. The GDP fell by more than 10 percent during the recession.[2] As a consequence, public budgets deteriorated when tax revenues fell and expenditures to support the unemployed rose. Education expenditure was cut at all levels of education.

The recession hit the local governments especially hard. The local governments are responsible for operating schools from primary level to senior secondary education. Prior to 1993, the local governments received earmarked cost-based grants for running the school system. The cost-based subsidies were abolished when the state grant system was reformed in 1993.[3] In the new system, the state grants are based on unit prices (expenditure per student) and the money is no longer earmarked for a special purpose. The actual level of school spending is decided by the local government but the state grant does not depend on actual spending. Thus, the scope for differences in education expenditure across municipalities has increased considerably. In senior secondary schools the average expenditure per student decreased by 25 percent from the year 1989 to 1994. On average, small schools cut their expenditure more than large schools, but there is a lot of variation in school spending even accounting for school size. On average over the whole 1990s, the teaching expenditure was about 2,700 euro per student. The changes in spending were related to the financial situation of the local government. An important question is whether the large cuts have affected the student achievement.

There are hundreds of studies that have addressed the question of how school resources affect student achievement. A survey of close to 400 studies of student achievement by Hanushek (1997) shows that there is no strong or consistent relationship between educational expenditure and student performance, but the question is still far from settled. The most difficult problem in estimating the causal effect of resources on achievement is that resources (class size or expenditure per student) can be correlated with unobserved school and student characteristics that also affect achievement. The causal relationships can be

[2] For a detailed discussion on the economic recession of the 1990s in Finland, see Honkapohja and Koskela (2001).

[3] Details of the state grant system reform can be found in Moisio (2002).

identified if resources and students are randomly allocated to different schools. One of the best-known examples of a random experiment is Krueger (1999), who used data from the Tennessee STAR experiment and found that students in small classes perform better. Some studies rely on "natural experiments" to create exogenous variation in class size, but results from these studies are mixed. For example, Angrist and Lavy (1999) find that class size reductions increase achievement in mathematics and reading, whereas Hoxby (1998) finds no significant class size effects. However, most of the previous research relies on cross-section data without controlling for the non-random allocation of students or resources.

The turbulent 1990s brought about changes in higher education as well and several reforms were made to cut the expenditure and increase the efficiency of the university system. In Finland, all universities are run by the state and they are not allowed to collect tuition fees. The government funding grew up to the early 1990s, when the recession resulted in cuts totaling 16 percent in 1993–1994 (KOTA database). In the second half of the 1990s the university funding was increasing again. The state funding has been gradually reformed since 1994 towards a system based on university outcomes. Government funding covers about 65 percent of the universities' operating costs. The rest comes from various sources, mainly as acquired funding for research and services.

Rising unemployment at the beginning of the 1990s generated conflicting pressures to higher education policy. On the one hand, increases in student places were demanded in order to mitigate the effects of youth unemployment; on the other hand, there was a need to prune down programs to correspond to the jobs actually available. A special education policy program intended to alleviate the effects of unemployment was issued in autumn 1992, increasing the number of places for new students at universities and open universities by almost 20 percent. (Ministry of Education, 1998). This was a significant increase in the supply of higher education.

The university admission is currently based on various subject-related entrance exams and grades in the national senior secondary school final exam. The admission process is very dispersed since the admission decisions are made independently at the department or fac-

ulty level at each university. Students are selected directly into different majors. Despite the increase in the number of student places for new students, competition for the slots in higher education is fierce and annual admission quotas apply to all fields of study. This has lead to a high median starting age in most fields of study. In fact, Finnish university students are on average 22 years old when they enter the university, which is rather high in international comparison. In addition, less selective programs suffer from high dropout rates when students succeed to get into other programs after a few years.

The public opinion is that the transition from senior secondary school to universities takes far too long and the Ministry of Education is interested in reforming the university admission process. For universities, the main object of the admission process is to select the best performing students since student performance has a direct effect on the government funding and on university's reputation. Studies on predicting achievement at higher education abound but there is little information on what the effects of a change in admission criteria would be for average student performance or composition of the student population.

The problems of the universities do not only concern the admission process. University studies in Finland also take, on average, much longer than intended. Most university programs are designed so that they can be completed in five years but the median time-to-degree is more than six years. Together with the high entry age, the long times-to-degree have resulted in relatively old graduates and concerns about the length of the working career.

One of the major reforms that aimed to increase the efficiency of the university students was the student financial aid reform carried out in 1992. With the student aid reform, the old loan-based student aid system was replaced with a system that relies on student grants. At the same time, the maximum duration of the student aid was reduced by approximately one year to 55 months. Currently, the maximum amount of study aid is 650 euro per month, of which 220 euro is loan. One of the main arguments for the student aid reform was that larger student grants would enable students to concentrate more on their studies, instead of dividing their time between studies and part-time work. Shorter grant duration should also

improve incentives to complete the studies within the grant period. However, students have been very reluctant to taking student loans and have rather been working to finance their costs of living. The formal target in the government action plan for higher education was that 75 percent of students should complete their master's degree in five years. Although the times-to-degree have shortened slightly, this has not been achieved. Considerable efficiency gains could be achieved if students accumulated the same amount of knowledge in five years than what they currently do in six or seven years.

Because of the long times-to-degree, student employment has become a highly debated issue in Finland. Roughly half of the university students work during their studies. Employment decisions are strongly affected by the availability of part-time jobs and student employment decreased during the recession. Working has increased constantly since the economy recovered from the recession. However, there is considerable variation in student employment across the different parts of the country.

Work during the semesters is likely to prolong studies and it may also interfere with learning and academic performance. However, there are also various positive consequences associated with student employment. Students are an important part of the labor force and provide a flexible reserve for labor. Working provides extra income for the students and work experience in the field of study may also complement the formal education and improve study motivation. Further, potential future employers may regard work experience as a signal for other attributes, e.g. high motivation and ability, and labor market contacts may improve employment opportunities after graduation. The essential question is whether the gains from working are larger than the distortion effects on achievement at university and on study time. Previous research on the US data has found considerable individual economic returns to working during college (e.g., Light, 2001). However, Hotz et al. (2002) argue that if the unobserved heterogeneity among college students is not taken into account, the returns might be overestimated.

Above, I have given a brief introduction to the issues covered in this thesis. In the following, I summarize each essay and present the main findings.

Essay I: School Resources and Student Achievement Revisited: New Evidence from Panel Data[4]

The first essay of the thesis analyzes the effects of changes in educational expenditure on changes in student performance in Finnish senior secondary schools in the years 1990-1998. This study uses a representative sample of nine cohorts of Finnish senior secondary school graduates. Repeated observations on schools enable us to eliminate any permanent differences between the schools and control for the neighborhood effects in a way that is not possible in cross-section studies. This study also controls for the family background and the student's initial level of achievement at the time of the secondary school entry. The study uses scores in compulsory school-leaving examination as the indicator of student performance.

The results are in line with much of the previous studies. Students' family background and earlier achievement have large effects on the school-leaving test results. We find no evidence that the changes in teaching expenditure have affected the test scores. The results are robust to changes in the model specification and to the choice of the dependent variable. At least in the short term, the schools have been able to reduce their spending without significant decreases in the test scores. However, the results do not imply that resources are totally irrelevant. Schools may have saved on other activities or teachers may have put extra effort on teaching in the short run. Some cuts in average spending were related to increases in school size, which may have increased the economic efficiency of the school due to increasing returns to scale.

[4] Written together with Tanja Kirjavainen and Roope Uusitalo.

Essay II: Do University Entrance Exams Predict Academic Achievement?

Each year, the number of university applicants in Finland exceeds the number of student slots by about three times. It is not irrelevant how students are selected from the pool of applicants. Admission rules should be designed to help in achieving education policy goals and they should be comprehensible, stable, fair, cost-effective and legitimate. Student quality is also of direct economic interest and universities are interested in predicting the academic achievement of the students when deciding which applicants to admit.

The second essay of this thesis addresses the questions on which admission criteria predict achievement at university and how a change in the admission rules would change the student population and the average achievement. This study uses data on three cohorts of students in the fields of engineering, social sciences, education and sport sciences from two Finnish universities.

The results show that about 15 percent of the variation in student achievement can be explained with the factors that are observable at the time of admission. The current university admission system is mainly based on a combination of grades in the compulsory senior secondary school final exam and the subject-related entrance exams. A large fraction of students would be admitted whether the admission was based on entrance exams, school performance or a combination of these. This is especially true for the field of engineering. In the fields of engineering, social sciences and sport sciences entrance exams predict both graduation and the number of study credits after four years better than past school performance. In education past school performance is a better predictor of graduation.

Changing the admission rule to school grades would affect the average student performance negatively in engineering and social sciences but positively in education. Using only entrance exams would not significantly change the average student performance in any field. However, people tend to adapt to regulatory frameworks and changing the admission rules could lead to changes in the pool of applicants. Unfortunately it is not possible to estimate the effects of the change in the pool of applicants.

Essay III: The Effect of a Student Aid Reform on Graduation: A Duration Analysis[5]

The third essay of this thesis evaluates the changes in the times-to-degree at Finnish universities in the 1990s, and in particular, the effect of the 1992 student aid reform. The study uses large individual level panel data that follow the students from the start of their university career to their eventual graduation. The data is based on a random sample of students who started their university studies between 1987 and 1995 and cover the years 1987-1999. In addition to the student aid reform, the data allow us to control for a number of other factors that may influence graduation times. Particularly important are large changes in the student employment opportunities that decreased at the beginning of the 1990s due to the recession. Large changes in the economic environment can be expected to influence graduation times, irrespective of how the student aid system was reformed. With individual level data from different parts of the country differing in the severity of recession, the business cycle effects on student employment, and hence on the graduation times, can be accounted for. A number of individual and family specific factors, as well as past school performance, can also be controlled for in the study.

The study finds that older, married, and female students have higher completion hazards and a higher student-teacher ratio lowers the graduation hazard. The results also indicate that the student aid reform had only a modest effect on the graduation times. The effect was concentrated in the fields with long average duration. This suggests that the limits in the aid duration were more important than a switch from the loan-based to the grant-based system. However, the most important reason for the slight decline in the times-to-degree appears to be the increase in unemployment that decreased student employment opportunities.

[5] Written together with Roope Uusitalo.

Essay IV: Working While Enrolled in a University: Does it Pay?

The results of the third essay in this thesis suggest that working is one of the main reasons for prolonged studies. On the other hand, working during the university studies has also many positive effects and the interesting question is whether the gains from work experience are larger than the negative effects on student performance. The fourth essay of this thesis estimates the effects of in-school work experience on employment and earnings after graduation. The study uses individual level panel data on Finnish university students from the years 1987-1998. The data include labor market outcomes of 3,700 graduates, who started their university studies between 1987 and 1995.

OLS estimates show that work experience during the enrollment is associated with higher employment probability and higher annual earnings after graduation. However, it is clearly not random who works and who does not work while studying at university. In addition to student's ability and preferences, local employment possibilities and labor market conditions during the studies define whether a student enters the labor market prior to graduation. Simply looking at returns to work experience without correcting for the selection would yield biased estimates.

Instrumental variable techniques are used to correct for the selection bias. The unemployment rate at the university location during the studies has a strong negative effect on students' work months, and it does not have a direct effect on employment status or annual earnings after graduation, provided that the local unemployment rate after graduation is controlled for. Thus, local unemployment rate can be used as an instrument for work experience. Using IV methods and comparing graduates with equal times-to-degree, the study finds that working yields almost 18 percent increase in earnings one year after graduation. The effect is positive but statistically insignificant in the later years. This estimate gives the return to working if working does not affect the elapsed time-to-degree, which would be a reasonable assumption if a student only worked during the holidays. However, it is likely that working delays graduation since many students also work during the school terms. If working is allowed to affect the time-to-degree, the estimate can be interpreted as a joint

effect of investing in job skills and prolonging the studies. The joint effect of work experience on earnings is only about 2-3 percent and it is statistically insignificant for all years in the IV models.

There are no significant effects on the employment probability after graduation when instrumental variable technique is used. Results are similar if the models are estimated for the entire entry cohort rather than just the graduates. Graduates' earnings are considerably higher than the earnings of dropouts.

The Ministry of Education in Finland is planning to restrict the maximum length of enrollment to the theoretical length of the program plus two years. Thus, in most cases the maximum length of enrollment would be seven years. This restriction could increase students' incentives to study more intensively and decrease student employment, which could have a negative effect on the graduates' earnings in the short term. However, the losses in earnings should be weighted against the returns to shorter times-to-degree.

References

Angrist, J. D. and V. Lavy (1999): Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *The Quarterly Journal of Economics* 114, 533-575.

Björklund, A., P-A Edin, P. Fredriksson, A. Krueger (2004): Education, equality and efficiency – An analysis of Swedish school reforms in the 1990s. *Report 2004:1, Institute for Labour Market Policy Evaluation.* Uppsala.

Hanushek, Erik A. (1997): Assessing the effects of school resources on student performance: an update. *Educational Evaluation and Policy Analysis, 19, 141-146.*

Honkapohja, S. and E. Koskela (2001): The economic crisis of the 1990s in Finland. In Kalela, J., J. Kiander, U. Kivikuru, H. A. Loikkanen and J. Simpura (Eds.), *Down from the heavens, up from the ashes. The Finnish economic crisis of the 1990s in the light of economic and social research.* VATT publications 27:6. Government Institute for Economic Research, Helsinki.

Hotz, V. J., L. Xu, M. Tienda and A. Ahituv (2002): Are there returns to the wages of young men from working while in school? *The Review of Economics and Statistics 84, 221-236.*

Hoxby, C. (1998): The effects of class size and composition on student achievement: new evidence from natural population variation. *NBER Working paper* 6869.

KOTA database. Administrated by the Ministry of Education, available online at http://www.csc.fi/kota/nuts.html

Krueger, A. (1999): Experimental estimates of education production functions. *The Quarterly Journal of Economics* 114, 497-532.

Light, A. (2001): In-school work experience and the returns to schooling. *Journal of Labor Economics 19, 65-93.*

Lleras-Muney, A. (2002): The relationship between education and adult mortality in the United States. *NBER Working paper 8986.*

Ministry of Education (1998): Higher education policy in Finland. Publications of Ministry of Education, Helsinki.

Moisio, A. (2002): Determinants of expenditure variation in Finnish municipalities. In Moisio, A., *Essays on Finnish municipal finance and intergovernmental grants.* VATT research reports 93. Government Institute for Economic Research, Helsinki.

Essay I

School Resources and Student Achievement Revisited: New Evidence from Panel Data*

1. Introduction

The effect of school resources on student achievement has been examined in hundreds of studies during the past thirty years. Still, the question is far from settled. Existing studies have failed to show conclusive evidence that additional resources to schools would improve learning. In his latest survey, Hanushek (1997) concluded that there is no systematic evidence that more resources, such as higher teacher-student ratios or per-student expenditures would improve student learning.[1]

A basic problem in analyzing the effect of resources on student achievement is that resources are likely to be correlated with unobserved characteristics that affect achievement. Typically poor school districts afford to spend less on education, but it is not clear whether low spending levels or other characteristics of poor neighbourhoods are responsible for the low achievement levels in these schools. On the other hand, rural schools with small number of students often have smaller classes and higher per student spending. The students in these rural schools may perform differently from urban schools for reasons unrelated to school resources.

Studies that use experimental data with random assignments to small classes provide the most convincing evidence on the effect of smaller classes and higher per student spending.

---

* Written together with Tanja Kirjavainen and Roope Uusitalo. The paper has been originally published in *Economics of Education Review 22 (2003), 329–335*.

[1] Other recent surveys on school resources and student achievement include Hanushek (1986), Betts (1996), Hedges & Greenwald (1996), and Card & Krueger (1996).

Random assignment removes any systematic correlation between the class size and unobserved variables, and hence, provides an unbiased estimate of the effect of class size on student achievement. One of the best-known examples is Krueger (1999), who used data from the Tennessee STAR experiment, and found that students in smaller classes performed better.

Some recent studies rely on “natural experiments” to create exogenous variation in class-size. Angrist and Lavy (1999) identify the effect of class size from discontinuous changes in class size imposed by Maimonides rule that determines the relationship between school enrolment and class size in Israel. Hoxby (1998) identifies the effect of class size from natural population variation in Connecticut school districts. Angrist and Lavy find that class size reductions induce a substantial increase in math and reading achievement. Hoxby finds no significant class size effects.

However, most studies on the effects of school spending use cross-section data. Even if the studies use a “value-added” specification as an attempt to control for the initial achievement level of the students, there is usually no attempt to control for the non-random assignment of students to different schools or to different classes. Since randomized experiments are rare and clever natural experiments hard to come by, it is useful to see if more traditional estimation methods could be used to control for the unobserved school-specific factors.

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. 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 the time-invariant differences across the schools, and our estimates are based on the differences in the changes in the school spending. Therefore, we can eliminate any permanent differences across the schools and control for the neighbourhood effects in a manner that is not possible in the cross-section studies. We can also control for family background differences and the initial level of achievement when students apply to the senior secondary schools.

Our data cover a period when school spending varied considerably across schools. Some local governments, who are responsible for school funding, suffered more than others from the recession in the early 1990s. Spending per student, adjusted for inflation, decreased on average by 25 percent, but the decrease was by no means uniform. In addition, the local government financing system was reformed in 1993, giving the local governments more discretion on how to spend the state subsidies they receive for running the school system.

Most studies on the effects of school resources use various standardized test scores as a performance indicator. Typically, these tests suffer from a selection bias, since only a non-random sample of students takes part in testing. In this study, we use results from the Finnish senior secondary school matriculation examination, which is compulsory for all students.

The rest of this paper is organized as follows. Section 2 summarizes the main features of the Finnish senior secondary school system. Section 3 discusses the data. Section 4 describes the recent developments in school resources. Section 5 presents the estimation results and section 6 concludes.

2. Features of the Finnish senior secondary schools

The Finnish senior secondary schools provide three years of general education for students who are between 16 and 19 years of age. About 37,000 new students start senior secondary school each year. This is roughly 50 percent of the age cohort. The other half of the age group enters vocational education. Only approximately 5 percent of the age group quit school after compulsory comprehensive school.

Admission to the senior secondary schools is selective, and it is based on the grade point average (GPA) in the comprehensive school. Competition to the best senior secondary schools is harder, and competition is generally harder in the larger cities. Therefore, the admission criteria and the average GPA of the accepted students vary across schools.

The senior secondary school concludes with a national matriculation examination that gives students a general qualification to apply for universities or for tertiary-level vocational studies. The examination is compulsory for all senior secondary school students. It is drawn up nationally, and there is a centralized body to grade the exam according to uniform criteria. The results are also standardized to be comparable across the years.

There are four compulsory exams in the matriculation examination: mother tongue, the second official language, one foreign language[2], and either mathematics or science and humanities exam[3]. In addition, candidates may voluntarily take additional exams in other foreign languages, or take both the math, and the science and humanities exams. The exams are held each spring and autumn during a two-week examination period. From 1996 onwards the candidates have been able to take the exam over the maximum of three examination periods. Before, the full exam had to be taken within the same period, usually in the spring term of the senior year.

Responsibility for funding senior secondary schools is divided between the state and the municipal governments. The system was reformed in 1993. Before, the municipal governments received a cost-based subsidy. In the new system, Ministry of Education confirms each year unit prices (expenditure per student) that are used to calculate the state subsidy. These unit prices are higher in small schools and in the municipalities that offer schooling in both Finnish and Swedish. The state subsidy covers 57 percent of the costs calculated by multiplying unit prices by the number of students. The actual level of school spending is decided by the local governments, the state grant does not depend on actual spending.

[2] For the Finnish-speaking majority, the other national language is Swedish and the compulsory foreign language is usually English.

[3] The science and humanities exam includes questions from physics, chemistry, biology, psychology, geography, religion, and history. Students can choose to answer questions from any subject area.

3. Data and variables

Our basic sample is drawn from the Employment Statistics (ES). This is the main labour market database of Statistics Finland with information on individual's income, employment status, education, household composition etc. Data are based on about 30 different official registers. Currently the 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 from the ES database.

The Matriculation Examination Board Register contains the grades in all subject exams and the time of examination for all students attending the exam. We use data for the years 1990–1998. We defined the year of matriculation examination as 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. Our sample includes only students who have attended the matriculation examination; we were not able to identify dropouts from those who have been accepted to senior secondary school, but have never started it.

In this study, we use the sum of test scores in six exams as the dependent variable. The scores in each exam range from improbatur (failed) to laudatur (excellent). To calculate the overall score the sub-scores in each exam are converted to a scale from 0 to 6[4]. About 10 percent of the candidates reach excellent (5.5-6.0) average test scores each year. Less than 5 percent of the candidates fail the examination.

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 average (GPA) in the comprehensive

[4] 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.

school. Grading scale in the comprehensive school is from 4 (fail) to 10. Some senior secondary schools accept all applicants regardless of their GPA, while for some schools the minimum GPA requirement is over 9.[5] The average GPA in our sample is 8.5.

We measure the students' family background by the parents' education using the ES data. The 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 usually required to complete different levels of education. We have also municipality-level information on the education level of the population and information on unemployment rate at the local labor market.

Other student-related information includes the student's gender and whether the student worked during the school year. 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.

We have cost information on 444 senior secondary schools from 276 municipalities. Data cover all day schools in Finland. Roughly three quarters of the total school expenditure is teaching expenditure, which comprises teachers' salaries, teaching materials, teacher training, and other teaching-related costs. Data on the teaching expenditure for the years 1987–1992 are collected from the educational expenditure registers of the National Board of Education. Data for years 1993–1997 are based on the municipality databases of Statistics Finland. In general, our cost data is very accurate. The main problem in the data is that if several senior secondary schools are located in the same municipality, the costs cannot be attributed to the individual schools. Since most municipalities in Finland have only one senior secondary school, this is an issue that concerns mainly larger cities. To ensure that

[5] As the fraction of the age cohort admitted to senior secondary schools has increased over the years, admission has become less selective. This causes a negative trend in the comprehensive school GPA of the accepted students.

our results are not affected by the aggregation level, we perform the empirical analyses also with a smaller sample of municipalities with only one senior secondary school.

The expenditure data include information on teaching expenditure and other costs both as absolute figures and as average costs per student. We deflated all cost variables to the 1997 prices.[6] Our principal measure of school resources is teaching expenditure per student, calculated as an average over the three years that the student was enrolled in the school. We consider teaching expenditure a summary measure of class size, teaching hours, and teachers' experience. It should be noted that teacher salaries are based on a nationwide union contract, and there is no across-school variation in salaries. Therefore, the variation in teaching expenditure per student depends almost entirely on the number of teaching hours per student.

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 examination results we collected from the Matriculation Examination Board Register, we were able to match school and background information for 20,505 students.

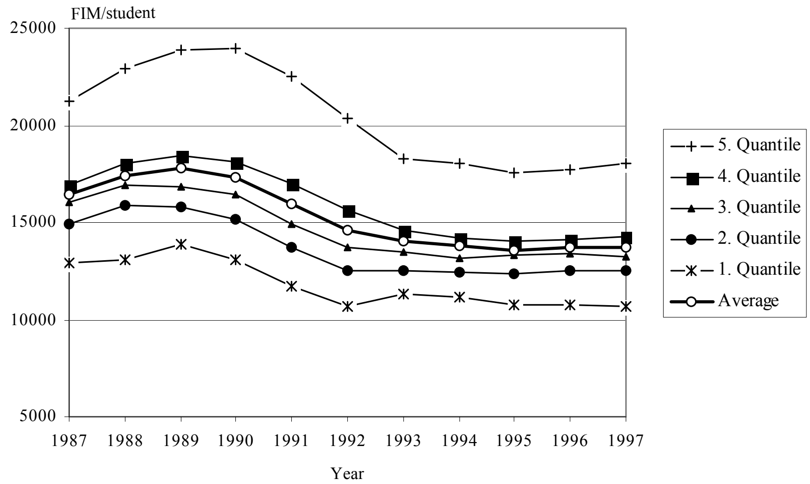
4. Developments in the school resources

The average teaching expenditure per student calculated over the period from 1987 to 1997 was FIM 16,000[7]. As shown in Figure 1, there has been substantial variation both between schools and over time. Average expenditure per student peaked in 1989. After that it decreased by 25 percent in five years. The decline was due to a severe recession that reduced tax revenue, increased social expenditure for the unemployed, and forced local govern-

[6] Wages, pension expenditures, 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.

[7] 1 FIM (Finnish markka) = 0.17 euro

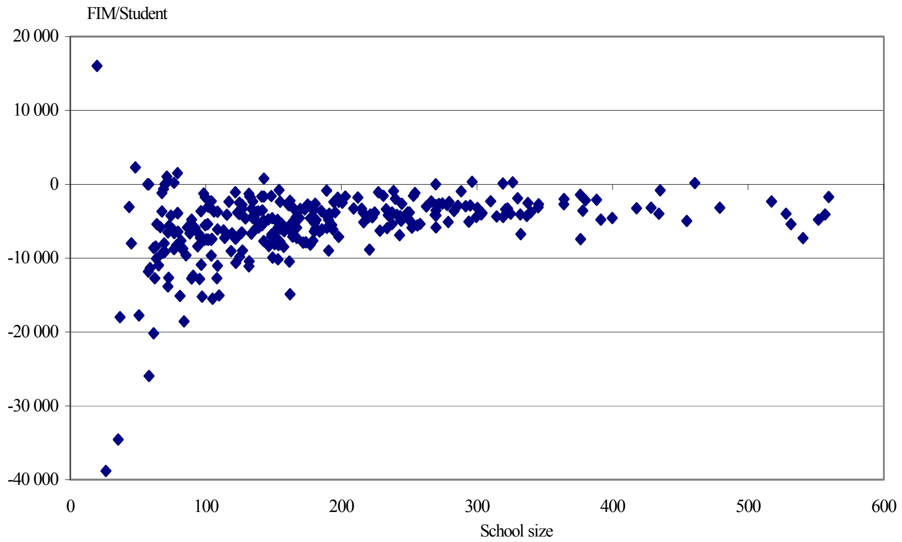
Figure 1. Changes in teaching expenditure per student.



ments to cut spending in all other activities. Figure 1 also shows that there is large variation in expenditure across schools in any given year. The average difference between the 1st and the 5th quintile is FIM 8,600. The most important factor explaining the between-school variation in spending is the school size. The schools with less than 100 students have considerably higher teaching expenditure per student than the larger schools.

We also demonstrate that there are large differences across schools in the changes of expenditure per student. Figure 2 shows changes between 1989 and 1994, i.e., during the largest drop in the average spending. There were only a few schools that did not experience any decline in expenditure. In thirty schools, teaching expenditure decreased by more than FIM 10,000 per student. On average, small schools cut their expenditure more than large schools, but there is considerable variation in the spending changes, even controlling for the school size.

Figure 2. Change in teaching expenditure by school size in 1989-94



There were 6 schools with more than 600 students that do not fit into the graph. In these schools changes in expenditures were less than FIM 2000 per student.

Detailed information on how these spending cuts were achieved is not available in our data. The National Board of Education reports that savings were made by increasing the class size and by decreasing the supply of voluntary courses and remedial instruction. Teacher salaries have been decreased by cutting holiday benefits and reducing compensation for other than teaching duties. Temporary substitute teachers were no longer hired. Also, spending on teacher training and teaching materials was reduced.

Eventually, we will use the teaching expenditure per student to explain student achievement. However, simply regressing achievement on resources leads to biased estimates on the effect of resources if the resources are correlated with other factors that affect student achievement. To examine the differences in school spending, 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 (tax revenues + state subsidies – spending). The equation also includes yearly dummies interacted with the inverse of the number of students in the municipality, which 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 is important not to restrict the effect of the number of students to be equal across the years.

Another way to interpret our regression estimates is that if expenditures depend on the economic situation in the municipality and the year-specific rules on expenditure per student, the total school expenditure can be written as

$$Exp_{it} = \alpha_t + \beta_t N_{it} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

where Exp_{it} is expenditure in municipality i in year t, N_{it} is the number of students and X_{it} is a measure of economic situation eg. the tax revenue of the municipality. α_t and β_t are year-specific coefficients. Dividing all terms by the number of students yields

$$Exp_{it} / N_{it} = \alpha_t \frac{1}{N_{it}} + \beta_t + \gamma X_{it} / N_{it} + \nu_{it} \quad (2)$$

We first estimate the model with random (municipality) effects panel regression. The results in the first column of Table 1 show that the economic situation of the local governments matters for school spending. The municipalities with higher tax revenue spend more per student, and the municipalities that are in high unemployment areas considerably less. Municipality's gross margin and local education level had no significant effects on school spending. However, these variables are highly correlated with the tax revenue. When the tax revenue was not included in the model, both variables had a strong positive effect on the school spending. In column 2, we add an indicator variable for urban area to the model. Apparently urban municipalities have lower per student teaching expenditure than rural municipalities even when the school size is controlled for.

Table 1. Determinants of teaching expenditure[a]

	RE (1)		RE (2)		FE (3)	
Tax revenue / inhabitant	0.23*	(0.09)	0.27**	(0.10)	-0.04	(0.11)
Local unemployment rate	-65.60**	(24.12)	-64.05**	(24.31)	-208.91**	(26.71)
Municipality's gross margin	-0.07	(0.07)	-0.08	(0.07)	0.01	(0.07)
Municipality's educational level	-3.28	(8.66)	4.45	(9.95)		
Urban area			-854.62	(563.02)		
Densely populated area			-1,224.04*	(438.17)		
Number of observations	2,464		2,464		2,464	
Number of municipalities	274		274		274	
R2	0.74		0.74		0.66	

[a]The dependent variable is teaching expenditure per student. All models include year dummies and year dummies interacted with the inverse of the number of students. Tax revenue per inhabitant, unemployment rate and municipality's gross margin are lagged by one year. Standard errors are in the parentheses. * significant at 5 % level, ** significant at 1 % level.

In column 3, we estimate the model with fixed municipality effects. The fixed effect specification removes all time-invariant differences between municipalities. According to the results, only the unemployment rate has a significant effect on school spending. The municipalities that experienced the highest increase in unemployment cut their school spending by the largest amount.

Above, we showed that in a cross-section, school resources are correlated with the size of the school, local education level, local unemployment level, municipality tax revenue, and population density. However, changes in spending are related to the financial situation of local government, and can be treated as exogenous in explaining changes in student achievement.

5. Results

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

First, since the matriculation exam results are standardized 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, the 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 a positive effect on learning, creating a correlation between school quality and achievement, even if school quality had no causal effect on learning. Even with data on 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.

Since we have repeated observations from each school, we can use panel data methods to control for the school-specific time-invariant factors. Our approach involves explaining the matriculation exam score with the grade point average in the comprehensive school, measures of family background, and school spending:

$$A_{ist} = \alpha + \beta R_{st} + \chi F_{ist} + \delta GPA_{ist} + u_s + \upsilon_t + \varepsilon_{ist}, \qquad (3)$$

where A is the matriculation exam score, R is a measure of school resources averaged over the three years that the student was 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 a two-way fixed-effect panel estimator. Therefore, u_s is a fixed school effect, υ_t a fixed time effect, and ε_{ist} a random error term.

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. First, in column 1 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 the GPA increases the matriculation exam score by almost eight points, which is equivalent to an increase of score in each exam by more than one grade. Also parents' education has a strong effect on the matriculation examination score, even when the comprehensive school GPA is controlled for. All else equal, boys do slightly better than girls.

The results show no effects of teaching expenditure on student performance. The estimates are positive but not significantly different from zero. The effect is rather precisely estimated. A 95 percent confidence interval for the effect of FIM 1,000 (5 %) increase in expenditure per student is from -0.04 to 0.08 points in the matriculation exam.

In Column 2 of Table 2, we add to the equation the local unemployment rate, the school size, and a dummy variable that indicates whether the student has been working during the school year. The school size and the 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 background or GPA. Altogether, the variables in the model explain 53 percent of the variance in the matriculation examination scores. About 10 percent of the remaining variance is attributed to the 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 qualitative differences are that the coefficient of the school size decreases and becomes statistically significant, and that boys are not performing better any more.

Table 2. Determinants of student achievement[a]

	(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)	0.30**	(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)	0.006	(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	-		-0.03	(0.02)	-		0.003	(0.03)
Number of students in school	-		-0.0002	(0.0002)	-		-0.003*	(0.001)
Number of observations	20,505		20,504		9,442		9,442	
Number of schools	444		444		245		245	
R2	0.530		0.531		0.535		0.536	

[a] 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). Standard errors corrected for the school-year clustering are in parenthesis. * significant at 5 % level, ** significant at 1 % level. In columns (3) and (4) only private schools and municipalities with one school are 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 columns include the year dummies and the school fixed effects.

We experimented with a number of different specifications to check the robustness of our results. First, we replaced the sum of test scores with the average score in the compulsory exams in order to focus on the tests that all students take. Second, we followed a suggestion by a referee and dropped the observations where per-student expenditure was below the 5th or above the 95th percentile to lessen the influence of extreme observations. Third, we estimated the effect of school spending on the 10th, 25th, 50th, 75th, and 90th quantiles of the achievement distribution. As argued by Eide and Showalter (1998) it is possible that cuts in spending hurt the weakest students even if the average achievement is unaltered. Finally, we estimated the effect of resources on the various sub-scores of the exam. We were particularly interested whether the cuts in resources would affect scores in voluntary exams as voluntary courses are more likely targets for the spending cuts than the "core" courses. None of these specifications produced significant estimates for the effect of teaching expenditure.[8]

[8] Results on the robustness checks are not reported here. Full results are available from the authors. More details can also be found in our discussion paper (Häkkinen, Kirjavainen and Uusitalo (2000)).

6. Conclusion

Our results are in accord with much of the earlier research on the effects of school resources. Students' family background and earlier achievement have a large effect on the matriculation examination results. As for the school resources, we found no significant effects on any of the exam results. This conclusion was not sensitive to changes in the model specification or on the choice of the dependent variable. At least in the short term, the schools have been able to reduce their spending without significant decreases in the test scores. This does not imply that resources would be completely irrelevant; schools may save on other activities, and focus on teaching in the subjects that are included in matriculation examination. As some cuts in average spending were related to increases in the school size, it may be that schools have become more effective due to increasing returns to scale. Other possible explanations include that teachers have exerted extra effort in the short-run, or that the test standards have been lowered. Nevertheless, our results show that at least the worst fears on the consequences of cutting resources from schools are not supported by the empirical facts.

References

Angrist, J. D. and V. Lavy (1999): Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *The Quarterly Journal of Economics 114, 533-575.*

Betts, J. (1996): Is there a link between school inputs and earnings? Fresh scrutiny of an old literature. In G. Burtless (Ed.), *Does money matter? The effect of school resources on student achievement and adult success.* Washington D.C.: Brookings Institution Press.

Card, D. and A. Krueger (1996): School resources and student outcomes: an overview of the literature and new evidence from North and South Carolina. *Journal of Economic Perspectives 10, 31-40.*

Eide, E. and M. H. Showalter (1998): The effect of school quality on student performance: A quantile regression approach. *Economics Letters 58, 345-350.*

Häkkinen, I., T. Kirjavainen and R. Uusitalo (2000): School resources and student achievement revisited: New evidence using panel data. *Government Institute for Economic Research, Discussion papers 227.* Helsinki: VATT.

Hanushek, E. (1986): The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature 24, 1141-1177.*

Hanushek, E. (1997): Assessing the effects of school resources on student performance: An update. *Educational Evaluation and Policy Analysis 19, 141-164.*

Hedges, L. and R. Greenwald (1996): Have times changed? The relation between school resources and student performance. In G. Burtless (Ed.), *Does money matter? The effect of school resources on student achievement and adult success.* Washington D.C.: Brookings Institution Press.

Hoxby, C. (1998): The effects of class size and composition on student achievement: New evidence from natural population variation. *NBER Working paper 6869.*

Krueger, A. (1999): Experimental estimates of education production functions. *The Quarterly Journal of Economics 114, 497-532.*

Essay II

Do University Entrance Exams Predict Academic Achievement?*

1. Introduction

In most European countries, university education has grown enormously during the past few decades. The enlargement of the secondary education has increased the number of eligible applicants at tertiary level, and as a result, universities have abolished free entry policy and created different kinds of student selection methods. Admission rules should be designed to help in achieving education policy goals and they should be comprehensible, stable, fair, cost-effective and legitimate. Student quality is also of direct economic interest and universities are interested in predicting the academic achievement of the students when deciding which applicants to admit. University admission processes have been formed during a long time and the way they have turned out to be is largely dependent on the whole education system and especially on the structure of the secondary education. In many countries, university admission is based on general aptitude tests, e.g. SAT scores, possibly combined with indicators of past performance at school and interviews or letters of recommendation. Some countries base their university admissions mainly on past performance or even lotteries, while others admit all applicants but only the best performing students may continue their studies after one or two years of study.

* I am grateful to Per-Anders Edin, Jonas Lagerström, Roope Uusitalo, Hanna Ågren, Björn Öckert, and the seminar participants at Uppsala University and FDPE labour workshop in Helsinki for valuable comments. I also thank Tuulikki Kaski and Pirjo Solin at the Helsinki University of Technology and Pekka Rahkonen and Jukka Hartikainen at the University of Jyväskylä for access to data. Financial support from Yrjö Jahnsson foundation and the Finnish Cultural Foundation is gratefully acknowledged.

In Finland, university admission is currently based on various subject-related entrance exams and grades in the national senior secondary school final exam, matriculation examination. Universities select their students independently and there are no national entrance exams. The problems of the current system are well known. Competition for the slots in higher education is fierce and annual admission quotas apply to all fields of study. In total, less than a third of the applicants are accepted. Competition and quotas force many applicants to apply several times before they are accepted to the desired program. This has lead to a high median starting age in some fields of study. In addition, less selective programs suffer from high dropout rates when students succeed to get into other programs after a few years. The admission decisions are made at the department or faculty level, which makes the admission system very dispersed.[1] The lack of coordination in the admission procedure is problematic from the applicants' point of view because the applicants have to take separate subject-related entrance exams for each university and retake the exam every year they want to apply to the university. The dispersed exam-based system might not be cost-effective for the universities either.

Studies on predicting student performance at higher education abound. However, there are few studies on how alternative admission systems would work and how reforms would change the composition of applicants or students. One of the most important questions for the universities is whether different admission rules lead to altered student populations and change in average student achievement. A subject-related entrance exam may measure motivation and applicant's interest in the field of study and might therefore predict academic success better than a general aptitude test or matriculation examination grades. Entrance exams may also be a second chance for students who have received low grades in school. On the other hand, entrance exams are costly for universities and for the society – especially if students apply several times before they get admitted. It is not self-evident that the current entrance exams measure the right things or give a realistic picture of what the actual studying is like. Also, admission rules that are based on past performance could result in

[1] In the 20 Finnish universities, there are a total of 540 units who make the admission decisions.

admitting the same individuals than admission based on entrance exams. In this case universities should choose the admission criteria that minimize the costs.

This study examines which factors predict academic performance. In particular it compares the predictive values of subject-related entrance exams and indicators of past school performance which are the instruments that universities can use in the student selection. The study also looks at the student and applicant composition and how the student population or average student performance would change if the admission criteria were changed. The study uses three cohorts of students from the University of Jyväskylä and Helsinki University of Technology (HUT). Engineering is the largest field of study and HUT is the oldest, largest and most selective university of technology in Finland, which makes it an ideal university to analyze factors that predict academic achievement in the field of engineering. However, one cannot draw conclusions from looking at one field and therefore, the study also uses data on students in the fields of social sciences, education and sport sciences from the University of Jyväskylä. University of Jyväskylä is a good example of a median Finnish multidisciplinary university.

The rest of this paper is organized as follows. Section 2 summarizes the previous literature on predicting student performance at tertiary education. Section 3 describes the university admission process in Finland. Section 4 introduces the data and variables. Section 5 introduces the methods used in evaluation. Empirical results are presented in Section 6 and Section 7 concludes.

2. Previous literature

There is an extensive literature concentrated on predicting student performance. This literature uses mainly correlation analysis and the main conclusion from these studies is that up to 25 percent of an individual's future educational success can be explained with factors that are observable at the time of the admission. The general finding is that grade point averages (GPA) from previous school and aptitude test scores provide the best forecast of

success, whether the success is measured as grades or completion of higher education. Betts and Morell (1999) study the determinants of first-year college grades at the University of California, San Diego, and find that personal background (gender, ethnic group, family income) and the socio-economic environment of the school are significantly linked to college GPA. In addition, high school GPA and SAT scores are strongly correlated to success at college, but predictions could be improved by adding background variables. Also Rothstein (2003) finds that much of the aptitude test's predictive power derives from its correlation with high school demographic characteristics.

Krueger and Wu (2000) study the determinants of success of 344 economics graduate students who applied for admission to a "top five" department in the U.S. in 1989. They determine the success by the students' job placement nine years after the beginning of the graduate studies and find that although there is considerable uncertainty in predicting which applicants will be placed in high-ranking jobs, the math graduate record examination, the subjective ratings of the admissions committee, and the prominence of reference letter writers are statistically significant predictors of applicants' subsequent job placements.

Öckert (2001) studies the completion probability and the effects of university studies on labor market performance using data from the admission selection process in Sweden in 1982. His results show that female applicants, applicants with long senior secondary schooling and high GPA from senior secondary school are most likely to graduate from university. Age at entry is negatively related to student performance.

There are also a few studies that have examined the admission procedure in Finland. Most studies find that senior secondary school grades are positively correlated with success in higher education. The correlation of entrance exams and success in studies is somewhat unclear because there are such many types of entrance exams. Lindblom-Ylänne et al. (1992) examine the correlation of an aptitude test and first year university grades for students in medicine and find that the test explains only a very small fraction of the variation in student performance. Gillberg (1987) analyzes students in business and finds that success in the entrance exam is negatively correlated with dropout probability but entrance exams

have no connection with times-to-degree. Rantanen (2001) studies non-university tertiary education in Finland and concludes that 60 percent of the applicants would have been admitted to the same program even if entrance exams were abolished and students were admitted on the basis of their past school performance. Rantanen finds that the best indicators for student performance are applicant's school and program preference ranking and the GPA from previous school. Performance in the entrance exam predicted student performance only in the field of engineering. Some studies have found that past performance in school and success in the entrance exam are quite weakly correlated, sometimes even negatively correlated (Silvennoinen et al., 1991; Ahola, 2004).

Most previous studies have looked at student performance at the beginning of the studies and usually for one field of study. This paper includes four fields of study and has access to yearly information on each student's study credits throughout the whole enrollment time, which enables the identification of dropouts and following the students from admission to graduation. In addition, the data sets used in this study include not only admitted students but all applicants, which makes it possible to calculate how the student population would change if different admission rules were used.

3. Features of the Finnish university system and admission process

The three-year Finnish senior secondary school concludes with a matriculation examination that provides general eligibility for university studies.[2] Matriculation examination is compulsory for all senior secondary school students. It is drawn up nationally, and there is a centralized body to grade the exam according to uniform criteria. The results are also standardized to be comparable across the years. There are four compulsory exams in the matriculation examination: mother tongue, the second national language, one foreign

[2] Individuals without the matriculation exam are eligible to apply for universities if they have at least three-year vocational qualification after compulsory schooling. However, there are very few applicants without the matriculation exam and these applicants are excluded from the empirical estimations.

language[3], and either mathematics or science and humanities exam[4]. The grades in each exam range from improbatur (failed) to laudatur (excellent), which are converted to a scale from 0 to 6 in this study. Mathematics exam is compulsory for students who have studied advanced mathematics courses in senior secondary school. Students may also voluntarily take additional exams in other foreign languages or take both the mathematics and the science and humanities exam. The exams are held each spring and autumn during a two-week examination period. From 1996 onwards the students have been able to take the exam over the maximum of three examination periods. Prior to 1996, the full exam had to be taken within the same examination period, usually in the spring term of the senior year. More than 50 percent of the age group completes senior secondary school.

Matriculation exam gives the general eligibility for studies at tertiary level, but universities select their students independently and there is restricted entry to all fields of study. The number of study slots at tertiary level is determined each year in performance negotiations between the Ministry of Education and the universities. Student selection may be based on the combination of senior secondary school grades, matriculation exam grades, and the entrance exam, which is the most common procedure; on the entrance exam alone; or on the grades in the matriculation exam and the senior secondary school final grades. In addition, some fields may place additional emphasis on work experience, previous studies or practical training. Entrance exams are designed by the university, faculty or department in question to assess the applicants' motivation, suitability and aptitude in the field concerned. The entrance exams are written subject-related tests with a book or two to read. There may also be interviews or exams based on material that is distributed at the beginning of the test, and students may be required to demonstrate their skills (e.g., at art academies).

Universities co-operate in organizing the student selection to varying degrees. The field of engineering and architecture applies a joint selection system, where each of the universities

[3] For the Finnish-speaking majority, the second national language is Swedish and the compulsory foreign language is usually English.

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

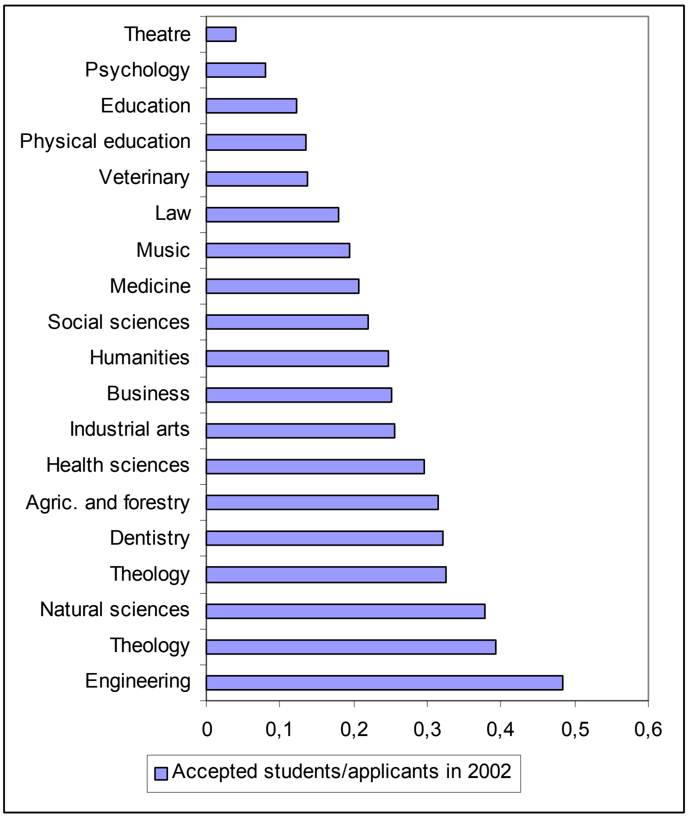
uses the same selection criteria and the same application form. There is also co-operation between universities in biology, languages, class teacher and kindergarten teacher education, and medicine. However, this co-operation does not constitute an actual joint selection system. For the most fields, there is no coordination of the entrance exams, required literature or dates of the exams. For example, in 2004, there are six universities providing education in sociology. An applicant to sociology could take four entrance exams in four universities and would have to choose between the two universities that have the exam at the same time. Also, the applicant might have to read different material for each of the exams.

In total, less than a third of the applicants are accepted, but there are huge differences in the acceptance rates between the fields and, to some extent, between universities. As shown in Figure 1, the lowest acceptance rates (less than 10 %) are in the fields of theatre and psychology, and the highest acceptance rates are in engineering (48 %), theology (39 %) and natural sciences (38 %).

Most students are accepted to programs leading to a Master's degree, which consists of one major and one or more minor subjects. Students usually apply directly to a specific major. The graduation requirement is, depending on the field of study, 160 or 180 credits. One credit corresponds roughly to one week of full-time study. The target duration of studies in most fields is five years, but the actual durations are usually longer. The median time-to-degree is roughly six years. Currently there are no strict limits on the duration of enrollment.

All Finnish universities are state-owned and their activities are mainly financed from the state budget through the Ministry of Education. In 2003, the proportion of state funding was about 65 percent of the operating costs. The rest comes from various sources, mainly as acquired funding for research and services. The state funding system has been gradually reformed since 1994 towards a system based on outcome. The core funding is based on unit

Figure 1. Share of accepted applicants by study field.



Source: KOTA database of Ministry of Education.

costs formula, and since 1998 part of the funding has been allocated on the basis of performance. The performance-based funds represent about 2.4 % of universities' operational expenditure. The criteria used in the evaluation of performance include among other things number of targeted degrees, number of completed degrees, and placement of graduates in the labor market. (Ministry of Education, 2004). Although the performance based funding is only a small part of the total expenditure, there is an incentive for the universities to select successful students who are able to finish their degree in reasonable time.

3.1 Admission process in the Helsinki University of Technology (HUT)

As mentioned in the previous section, universities of technology have a unique joint application system, which enables students to apply to all universities with one application. The details of the admission rules are summarized in Table 1. In 1986, 1990 and 1995, each applicant had to take two exams, one in mathematics and one in physics, chemistry or social sciences depending on the desired program. Applicants were also given entry credits, which are called initial entry points, on the basis of matriculation exam and senior secondary school grades. In 1986 and 1990, initial entry points were based on the compulsory exams in the matriculation examination, points from questions in physics or chemistry in science and humanities matriculation exam, senior secondary school final grades in mathematics and physics or chemistry, and senior secondary school GPA. In 1995, only senior secondary school final grades in physics or chemistry and compulsory exams in the matriculation exam gave initial entry points. Total admission points are calculated summing up initial points and entrance exam points. Entrance exam constituted 47 percent of the total points in 1986 and 1990, and 65 percent in 1995.

In 1986, the admission of all students was based on total points. In 1990 and 1995, 80 percent of the students were selected on the basis of total points and the remaining 20 percent were selected ranking the applicants according to their entrance exam points. Students are admitted directly into different majors. Due to the higher demand, popular majors have higher entry requirements. Each major makes up a separate admission quota group.

80 percent of the students in engineering are male. Unlike in most other fields, new entrants are on average 19 years old and about 70 percent of the new enrollees at HUT have finished their senior secondary school in the same year. About one thousand new students are admitted each year. The number of accepted students and the fraction of students who decide to enroll have been quite stable in HUT during the time period that is analyzed in this study (figure 2). The number of applications and new students did not grow much until the end of the 1990s. It is also worth noting that nearly all admitted applicants decided to enroll be-

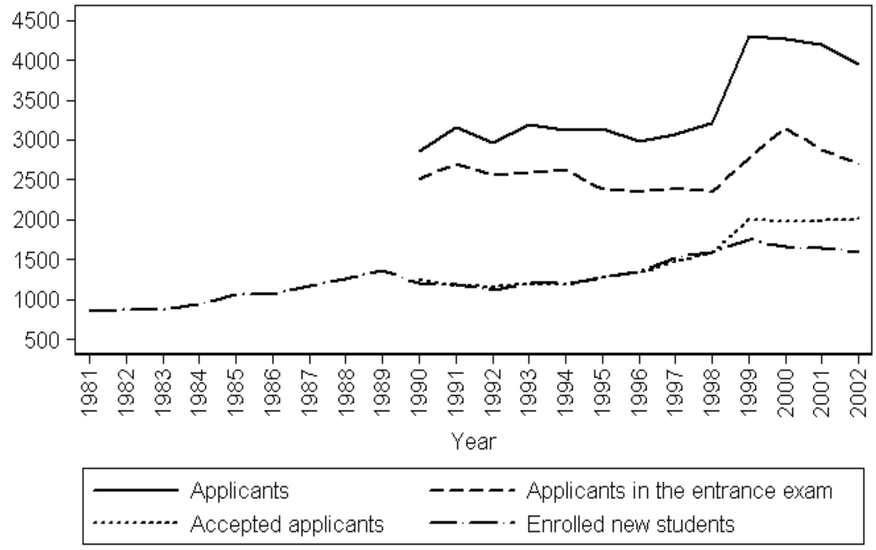
Table 1. Summary of admission rules.

	Engineering			Social sciences	Sport sciences	Education
Year	86	90	95	92, 95, 97	92, 95, 97	92, 95, 97
Total points						
1. Initial points						
i. Matriculation exam						
a. Mother tongue[a]	X	X	X	X	X	X
b. 2nd national language[a]	X	X	X		X	X
c. Foreign language[a]	X	X	X	X	X	X
d. Mathematics/Science[a]	X	X	X	X	X	X
e. Other foreign language					X	X
f. Science/Mathematics	X[b]	X[b]			X[e]	X[g]
ii. Senior secondary school grades						
a. Average (GPA)	X	X	X	X	X	X
b. Subjects	Math Phys/Chem	Math Phys/Chem	Phys/Chem		Sports	
iii. Other merits						
a. Work experience					In field	
b. Previous studies					In field	Tertiary
c. Other					Gender	
2. Entrance exam points						
i. Written exam	Math Phys/Chem/ Soc [c]	Math Phys/Chem/ Soc [c]	Math Phys/Chem/ Soc [c]	Subject related	Subject related	Subject related
ii. Aptitude test				X[d]	X	
Exam's weight in total points	47 %	47 %	65 %	50 %	55 %[f]	55 %
Admission rule						
i. Total points	100 %	80 %	80 %	80 %	100 %[f]	50 %
ii. Entrance exam points		20 %	20 %	20 %		50 %

Notes: a=compulsory exam, b=questions in physics/chemistry, c=depends on applied major, d=Psychology applicants, e=higher weight on compulsory exams, f=weights for entrance exam points differ between majors, the applicants with highest initial points are invited to the entrace exams, g=four best exams.

cause prior to 1999 one could be admitted to and enroll in several universities in the same year.

Figure 2. Number of applicants, accepted applicants and enrolled new students in Helsinki University of Technology.



Source: KOTA database of Ministry of Education.
Note: From 1999 onwards a student can enroll as a new student in only one university program in a given year. This explains the larger difference between the accepted applicants and enrolled new students after 1998.

3.2 Admission process in the University of Jyväskylä

The details of the admission rules in the University of Jyväskylä are summarized in Table 1. The admission rules were about the same in all of the years analyzed (1992, 1995 and 1997) but differed between the fields of study. Half of the students in education were selected using only subject-related entrance exam, the other half of the students were selected on the basis of total points. Total points were calculated summing up entrance exam points and initial entry points, which were based on four best grades in the matriculation exam, senior secondary school GPA, and extra points from previous tertiary level studies. Entrance exam made up 55 percent of the total points. Each year, roughly 45 students are admitted to education. 94 percent of the students in education are female and students are on average 22 years old when they enter the program.

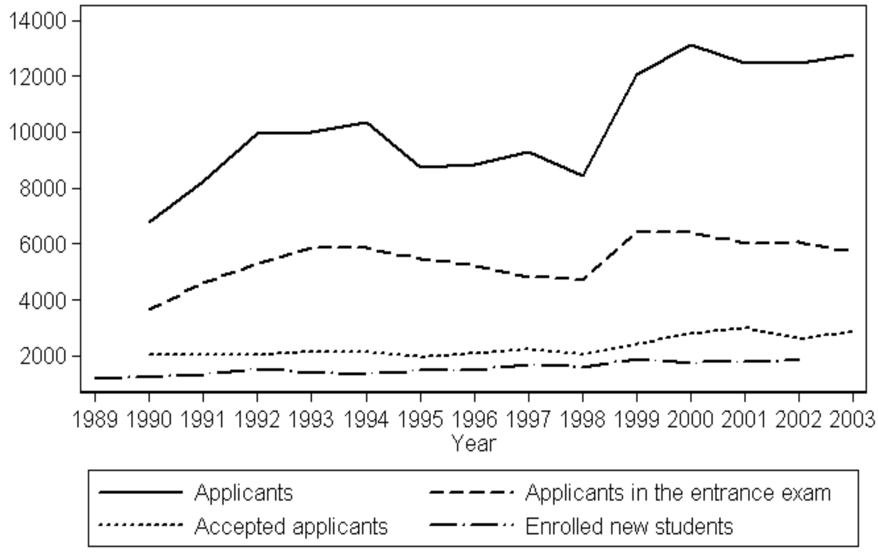
In the years analyzed in this study, 80 percent of the students in social sciences[5] were selected on the basis of total points and the remaining 20 percent were selected ranking the remaining applicants according to their entrance exam points. Entrance exam constituted 50 percent of the total points. Initial entry points were based on senior secondary school GPA, matriculation exam grades in mother tongue, foreign language, and mathematics or science and humanities exam. In addition, the applicants to psychology had to take a special aptitude test. Each year, roughly 230 students are admitted to social sciences. About 60 percent of the admitted applicants are female and only 18 percent are senior secondary school graduates of the same year. The average age at entry is 21.9 years.

Students in sport sciences were selected in two phases. First, applicants were ranked based on their matriculation examination grades, senior secondary school GPA and grade in physical education, work experience as a gym teacher or studies in the field. About 300 best male and 300 best female applicants were then invited to take the written entrance exam and the aptitude test measuring athletics and teaching skills. Students were ranked according to the sum of exam points and initial entry points, giving a different weight to the initial points in different majors. Entrance exam constituted about 55 percent of the total points. About 80 students are admitted each year and each major forms its own admission quota. 55 percent of the new entrants are female and the proportion of recent senior secondary school graduates is about 12 percent.

The number of accepted students and the fraction of students who decide to enroll have been very stable in the University of Jyväskylä between the years 1992, 1995 and 1997 (figure 3). For the fields studied in this paper, roughly 15 percent of the admitted applicants decide not to enroll.

[5] Social sciences include philosophy, political science, psychology, social policy, social work, sociology, statistics, economics, business, and information systems science. Students are admitted directly into majors.

Figure 3. Number of applicants, accepted applicants and enrolled new students in University of Jyväskylä.



Source: KOTA database of Ministry of Education.
Note: From 1999 onwards a student can enroll as a new student in only one university program in a given year. This explains the larger difference between the accepted applicants and enrolled new students after 1998.

4. Data

This study uses data from two universities, the Helsinki University of Technology (HUT) and the University of Jyväskylä. The data from HUT is based on the joint application register to Master's programs[6] in technology in 1986, 1990 and 1995. Students in architecture and landscape architecture are excluded from the sample because of the different admission procedure. The data from the University of Jyväskylä includes individuals who applied to Master's programs in education, social sciences, or sport sciences in 1992, 1995 and 1997. The data sets include both admitted and rejected applicants. Information is collected on each applicant's age, gender, mother tongue, senior secondary school graduation year,

[6] Master's degree is the first degree in Finland.

grades in the senior secondary school final exam (matriculation examination) converted to a scale from 0 to 6, senior secondary school grade point average (GPA), scores in the entrance exam, initial entry points based on past performance, preference ranking of the majors, and acceptance information (university, rank of the student in the quota, accepted applicant's major). Unfortunately there was no acceptance information for the students in sport sciences and for the 1995 and 1997 starting cohorts of students in education. Therefore, we can observe the accepted applicants who enrolled into these programs, but we cannot distinguish an admitted applicant who did not enroll from a rejected applicant. However, this does not cause any problems when we are looking at the achievement of the enrolled students.

Initial entry points are points that admission units calculate from the matriculation examination grades, senior secondary school grades and possibly some other indicators of past performance. Initial entry points are calculated differently for each field as described in the previous section. To be able to compare entrance exam scores and initial entry points, percentile ranks within the admission quota (major) are used instead of actual scores. To be able to make comparisons across the fields, different components of the initial points as well as an alternative measure for initial points, which is calculated similarly for all fields, are used in the estimations.

The applicant registers are matched with the student registers of the corresponding universities. The student registers contain yearly information on student's enrollment, academic achievement (number of credits and courses taken) and time of the graduation. Students are followed from the entry year to the fall of 2003. A student is defined as a dropout in the year after which no study credits are achieved. Student register information is naturally only available for admitted applicants who have decided to enroll. There is no information on study success for the rejected applicants or admitted applicants who did not start their studies. Further, the data do not include information on whether these applicants were ad-

mitted later or to other programs in other universities[7]. This creates a selection problem that is discussed in the next section. The data include 3,278 students in engineering, 687 students in social sciences, 249 students in sport sciences and 133 students in education. Descriptive statistics of the applicants and enrolled students are presented in the Appendix in Table A1.

5. Methods

It is not self-evident how "academic achievement" should be defined when trying to analyze which factors predict achievement. The university might be interested in admitting students that receive high grades, but clearly that is not the only measure of success. Since the times-to-degree in Finland are very long and the government funding is partly based on the received degrees, one interesting issue is how to select students who will graduate in the targeted time. In addition, universities might be interested in predicting the dropout rates of different types of applicants. Furthermore, graduate placement in the job market is also an interesting issue. How graduates succeed in the labor market after graduation is an indicator of school quality which affects the pool of applicants. Graduate placement is also a factor in the government funding formula. Unfortunately, the data in their current form do not include any labor market information on students or their job placements after graduation. Thus, this study concentrates on predicting the number of credits received during the first four study years and the probability to graduate within seven years.

The university's problem is to identify a subset of the applicant pool most likely to be academically successful. Following Rothstein (2003), the university's assessment of student i is given by

$$E[y_i \mid S_i, X_i] = \alpha + S_i\beta + X_i\gamma, \qquad (1)$$

[7] Except for engineering, where acceptance (but not enrollment) information was available for all universities of technology for the years 1986, 1990 and 1995.

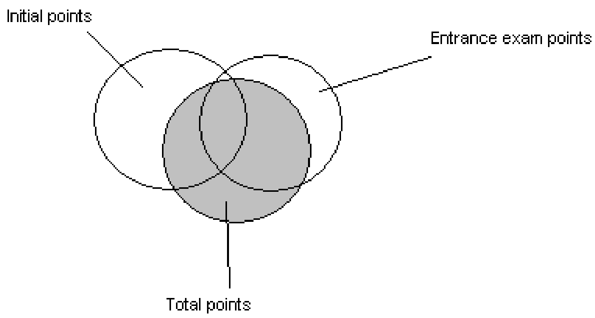
where y_i is a measure of the student's success at university (e.g. grades, number of credits), S_i is the student's entrance exam score, and X_i is a vector of other admissions variables (e.g. matriculation exam grades). The conditional expectation is assumed to be linear and additive.[8]

The population for whom outcomes are to be predicted is the group of potential applicants, while success in university can only be observed for enrolled students. Since one cannot observe how well rejected students would have performed had they been admitted to the university, the sample is selective. However, the data include all information that is used when selecting the students from the pool of applicants. Under the selection-on-observables assumption the OLS estimates for admitted applicants reflect the predictive power of entrance exams and other admission criteria for all applicants. However, since there are no observations on the admitted applicants who did not enroll and the enrollment decision might not be random, the estimates might still be biased. The probable explanation why admitted students do not enroll is that they get accepted to other programs. Unfortunately this is not observed in the data. Since the number of admitted applicants who do not enroll is quite small, this should not be a major problem.

The basic analysis is based on an OLS regression model where the number of credits after four study years is used as the dependent variable. Only a small fraction of students graduates in less than four years. However, 10–15 percent of the students drop out. The OLS models are estimated both including the dropouts and conditional on studying in the fourth year. In addition, linear graduation probability models are estimated for the student population. The empirical models are estimated separately for each field but pooling the data for the three entry cohorts and adding cohort dummies to the models. The results do not change much if models are estimated separately for each cohort.

[8] A variety of tests and model specifications including higher terms do not offer any evidence against the linearity assumption.

Figure 4. Illustration of the intersections of the admission rules.



Second part of the empirical analysis considers the effects of changes in the admission rules on achievement of the student population. Changing admission rules could lead to a different student composition. Figure 4 illustrates three admission rules, initial entry points, entrance exam and total points, which is the sum of initial points and entrance exam points. How much these admission rules overlap is a question that can be answered empirically. Taking the two extreme admission rules as an example, 74 percent of the admitted students in engineering would be admitted regardless of the admission being based solely on past performance or on the entrance exam alone (Table 2). The student composition would change more in social sciences, sport sciences and education. 36 percent of the admitted students in social sciences, 28 percent in sport sciences and 46 percent in education would be admitted regardless of the admission being based on initial entry points or entrance exam.

Since the different admission rules are likely to select more or less the same students in the upper end of the distribution, the mean academic achievement whether measured as graduation or study credits could be the same regardless of the selection criteria. Therefore, it is more interesting to compare applicants who would change their admission status when the admission criteria are changed. The first column of Table 3 presents the age and gender distributions of the applicants in the sample who would be admitted using entrance exams but rejected if admission was based on initial points only. The second column presents the

Table 2. Number of students whose admission is dependent on the admission criteria.

	Engineering	Social sciences	Sport sciences	Education
Total number of applicants	7,758	5,552	1,286	575
Number of admitted applicants	3,430	952	227	139
Would be admitted using either entrance exam or initial points	2,526	344	63	64
Would be admitted using entrance exam but not using initial points	904	608	164	75
Would be admitted using initial points but not using entrance exam	904	608	164	75
Would not be admitted using either criteria	3,424	3,992	895	361

Table includes three cohorts of applicants. Results are very similar for each cohort.

Table 3. Age and gender distributions of applicants who would change admission status when admission criteria are altered.

	(1) Admitted using entrance exam, but not using initial points	(2) Admitted using initial points, but not using entrance exam	(3) Difference (1) – (2) (std error)
Engineering	(904 obs)	(904 obs)	(1,808 obs)
Fraction of female applicants	0.102	0.287	-0.185** (0.018)
Mean age at entry	20.37	19.96	0.408** (0.100)
Fraction of new senior secondary school graduates	0.428	0.378	0.050* (0.023)
Social Sciences	(608 obs)	(608 obs)	(1,216)
Fraction of female applicants	0.516	0.696	-0.179** (0.028)
Mean age at entry	22.61	20.70	1.903** (0.184)
Fraction of new senior secondary school graduates	0.081	0.421	-0.339** (0.023)
Sport Sciences	(164 obs)	(164 obs)	(328 obs)
Fraction of female applicants	0.470	0.720	-0.250** (0.053)
Mean age at entry	21.63	20.70	0.933** (0.271)
Fraction of new senior secondary school graduates	0.158	0.390	-0.232** (0.048)
Education	(75 obs)	(75 obs)	(150 obs)
Fraction of female applicants	0.920	0.933	-0.013 (0.043)
Mean age at entry	23.31	21.44	1.867* (0.726)
Fraction of new senior secondary school graduates	0.028	0.333	-0.305** (0.058)

The sample used includes only students who are admitted using one admission criteria, either entrance exam or initial points, but not with both admission criteria (rows 4 and 5 in Table 2) . Standard errors in the parenthesis are from a robust regression. * significant at 5 percent level; ** significant at 1 percent level. The results in column 3 are unchanged if controls for the applied major and starting cohort are included.

distributions for applicants who would be admitted if initial points were used but rejected if entrance exams were the only selection criteria. Entrance exams select more male students and older students than initial points. A smaller fraction of new senior secondary school graduates would be admitted if only entrance exams were used. This might be due to the learning effect, i.e. older applicants might be applying to the university for the second or third time and have more information on how one should prepare for the entrance exams. Female applicants have higher matriculation exam grades which explains why females would benefit if students were selected on the basis of past performance.

We can see how the student population would change if the admission criteria were altered, but there are no observations on the achievement of the rejected applicants who would have been admitted using other criteria. Since the admission is based on observables, the success in studies can be predicted for the applicants that were not accepted or did not enroll using the results on the enrolled students. Predicting the performance of the admitted but non-enrolled applicants is not problematic since they are very similar in their observable characteristics to enrolled students. Predicting the performance at university for the rejected applicants has to be done by running out of sample predictions, since there is very little overlap in the entrance exam results between the admitted and rejected applicants. Since the admission weighs the entrance exam more than the past school performance, there is some overlap in the matriculation exam and senior secondary school grades between the admitted and rejected applicants. Out of sample predictions rely heavily on functional form assumptions. Within the sample (enrolled students), the relationship between entrance exams and study credits after four years is linear and it is assumed in this study that the relationship is linear also for the lower tail of the entrance exam distribution. Using higher moments of explanatory variables in the performance prediction does not affect the qualitative results.

The range of the entrance exams and indicators of past performance is restricted in the sense that those who have performed poorly in school and who are likely to perform poorly in the entrance exam do not apply to university. Therefore, if the regressions were run for the whole population, the university admission criteria would probably explain a much

higher proportion of the variation in achievement at university. Nevertheless, the predictions for the population are not very interesting for the university's decision making.

Altered admission rules could affect the pool of applicants because people adapt to regulatory frameworks. However, there is no straightforward way to analyze what the effects would be for the pool of applicants. A survey on senior secondary school graduates finds that applicants with high grades prefer admission that is based on school grades or subject-related tests whereas applicants who did not excel in school prefer general aptitude tests (Garam and Ahola, 2001). Admission rules based on past performance could increase retaking passed matriculation exams and senior secondary school courses. Grade inflation, retaking passed courses or choosing easier courses at senior secondary school to get better grades has become a problem in Sweden, where university admission is largely based on past performance (SOU 2004). Using entrance exams as the sole admission rule could encourage individuals with lower school grades to apply to university but also discriminate new senior secondary school graduates who have less time to prepare for the entrance exams than older applicants.

6. Results

OLS regression results on the number of study credits after four years are presented in Table 4. The sample used includes all admitted and enrolled students, regardless of their student status in the fourth year. Some of the students have graduated, dropped out or changed field of study, but the cumulative number of study credits can still be calculated for all individuals who enrolled at least in the first year. Since each major within the field of study forms an admission quota, all models include controls for the major subjects. The possible cohort effects are controlled with dummy variables for the admission year. In addition to the controls for student's major and cohort, the first column for each field includes percentile ranks of entrance exam score and field specific initial entry points. The results show that students with high rank in the entrance exam have more study credits after four years. The magnitude of the effect varies between the fields of study and it is statistically signifi-

Table 4. OLS estimates of cumulative number of credits after four years.

	Social sciences		Sport sciences		Education		Engineering	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank of	90.775***	82.353***	35.445**	30.991*	37.236*	37.469*	54.430***	59.875***
entrance exam	(18.960)	(18.738)	(16.650)	(16.700)	(20.031)	(19.532)	(5.545)	(5.515)
Rank of initial	11.683	7.239	29.274**	20.937	37.088	39.934*	5.313	5.225
points	(7.611)	(8.568)	(11.293)	(12.712)	(22.529)	(20.432)	(4.178)	(4.244)
Female		19.972***		4.040		-57.486***		20.436***
		(4.855)		(7.009)		(17.286)		(2.646)
Age at entry:		10.407**		-3.704		-14.364		15.229***
21-23		(4.347)		(6.908)		(8.722)		(3.035)
24-		6.425		-22.187**		-17.313		3.992
		(6.534)		(10.536)		(15.797)		(7.060)
Observations	687	687	244	244	133	133	3,278	3,278
R-squared	0.12	0.14	0.06	0.09	0.07	0.14	0.08	0.11
F statistic	7.65	8.09	2.43	2.55	2.24	4.41	17.19	19.30
(Prob>F)	(0.0000)	(0.0000)	(0.0201)	(0.0061)	(0.0679)	(0.0002)	(0.0000)	(0.0000)

Robust standard errors in parentheses. * significant at 10 %; ** significant at 5 %; *** significant at 1 % level. All models include controls for student's major and entry cohort. The excluded entry age group is 18-20-year-olds.

cant at 5 % level for all fields except for education. The coefficient of the initial points percentile rank is positive but much smaller and statistically significant only for sport sciences.

Background variables in student performance prediction are not particularly informative about admissions policy, but they are still interesting. It is plausible that entrance exam score and school grades are correlated with socio-economic background of the student that predicts the student performance. The data include information on student's gender and age. These are added as controls in the second column for each field in Table 4. The coefficient of the entrance exam rank is more or less unchanged. The effect of the rank of initial points is diminished for social sciences, engineering and sport sciences. For the field of education, the effect of the rank of initial points increases slightly and it is significant at 10 % level. Female students have more study credits after four years in all fields except in education. The deviating gender effect for education is probably due to the very small number of male students in the field. Female students have on average higher grades in the matriculation examination and therefore higher initial points. When gender is not controlled for, the percentile rank of initial points partly captures the gender effects. There are no statistically significant age effects for the field of education. Students who are 21-23-years old when they enter the university perform better than 18-20-year-olds in the fields of engineering

and social sciences. Students who are older than 23 when they enter the university perform worse in sport sciences.

Since initial points are calculated differently in each field, it is difficult to make comparisons between fields. Therefore, Table 5 uses an alternative measure of initial points that are calculated similarly for all fields. Initial points in Table 5 include four compulsory exams in matriculation exam and senior secondary school GPA. The results do not change much for social sciences, because this measure of initial points is very similar to the way the real initial points are calculated. For the other fields, the coefficient of the rank of initial points is diminished.

It is also possible to look at how the different components of initial points predict cumulative number of study credits. Table 6 includes entrance exam ranks, senior secondary school GPA and matriculation exam grades in the compulsory exams. The sample size in these regressions is smaller because all matriculation grades were not available for some students. Senior secondary school GPA is a good predictor of study credits at university in all fields but matriculation exam grades are mostly insignificant and even negative. The variation in the matriculation exam grades is not very large among the admitted students; the maximum grade in the matriculation exam is 6 and the mean grade in the student population is about 5. Therefore, it is not so surprising that the explanatory power of matriculation exams is so poor. Results do not change even if rank of entrance exam is excluded from the regressions. None of the coefficients in the field of education are statistically significant because of the small sample size.

Table 5. OLS estimates of cumulative number of credits after four years using same initial points for all fields.

	Social sciences		Sport sciences		Education		Engineering	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank of	88.540***	82.303***	32.455*	28.999*	30.440	33.706*	54.730***	60.010***
entrance exam	(18.976)	(18.800)	(17.371)	(17.493)	(21.348)	(19.631)	(5.548)	(5.513)
Rank of initial	15.204**	8.182	5.455	-6.243	7.532	17.565	3.421	-0.014
points[a]	(7.284)	(7.601)	(10.805)	(10.894)	(17.530)	(16.467)	(3.631)	(3.651)
Female		20.047***		8.947		-54.907***		20.858***
		(4.876)		(6.729)		(16.193)		(2.657)
Age at entry: 21-23		8.496**		-4.099		-20.605**		14.521***
		(4.216)		(6.931)		(8.681)		(2.988)
24-		4.625		-25.007**		-22.342		3.029
		(6.081)		(10.671)		(15.933)		(7.031)
Observations	687	687	244	244	133	133	3,278	3,278
R-squared	0.12	0.15	0.04	0.08	0.04	0.12	0.08	0.11
F statistic	7.67	8.10	1.30	2.21	1.38	3.70	17.13	19.31
(Prob>F)	(0.0000)	(0.0000)	(0.2519)	(0.0180)	(0.0370)	(0.0011)	(0.0000)	(0.0000)

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% level. a initial points are calculated similarly for all fields including four compulsory matriculation exams and senior secondary school GPA (max. 34 points). All models include controls for student's major and entry cohort. The excluded entry age group is 18-20-year-olds.

Table 6. OLS estimates of cumulative number of credits after four years. Matriculation exam results.

	Social sciences	Sport sciences	Education	Engineering
	(1)	(2)	(3)	(4)
Rank of entrance exam	83.731***	19.042	38.884	54.256**
	(21.405)	(18.553)	(24.325)	(5.575)
Senior secondary school GPA	12.824***	19.472***	22.021	14.936***
	(4.797)	(6.817)	(13.281)	(2.135)
ME grade mother tongue	-5.452*	1.649	8.511	-3.658***
	(3.075)	(4.482)	(6.101)	(1.206)
ME grade mathematics/science	0.071	1.598	-3.986	-0.947
	(1.889)	(2.668)	(3.726)	(1.423)
ME grade foreign language	-6.705**	-5.510	-3.918	-4.329***
	(2.773)	(3.344)	(6.252)	(1.076)
ME grade the other national language	4.424	0.205	-4.570	0.649
	(3.377)	(3.832)	(9.063)	(1.156)
Observations	520	214	110	3,267
R-squared	0.16	0.12	0.09	0.10
F statistic	6.58	2.71	2.37	17.78
(Prob>F)	(0.0000)	(0.0028)	(0.0220)	(0.0000)

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% level. All models include controls for student's major and entry cohort.

Table 7. OLS of cumulative number of credits after four years if students who drop out within four years are excluded from the sample.

	Social sciences		Sport sciences		Education		Engineering	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank of	88.230***	79.576***	26.851*	26.321*	32.023*	30.878*	34.573***	42.142***
entrance exam	(18.725)	(18.047)	(14.011)	(14.187)	(17.580)	(16.481)	(4.607)	(4.467)
Rank of initial	15.337**	8.791	28.166***	26.690**	49.469**	53.174***	21.269***	24.599***
points	(6.898)	(7.667)	(9.515)	(10.976)	(21.613)	(19.295)	(3.577)	(3.521)
Female		21.599***		1.250		-38.110**		26.380***
		(4.102)		(6.279)		(17.863)		(1.969)
Age at entry:		8.621**		0.442		-14.554**		24.075***
21-23		(3.765)		(5.898)		(6.554)		(2.448)
24-		5.548		-3.344		-5.445		23.260***
		(5.654)		(10.731)		(15.233)		(6.758)
Observations	609	609	219	219	114	114	2,772	2,772
R-squared	0.11	0.15	0.10	0.10	0.18	0.27	0.12	0.21
F statistic	6.07	7.14	3.64	2.65	6.52	5.18	23.31	37.40
(Prob>F)	(0.0000)	(0.0000)	(0.0010)	(0.0046)	(0.0001)	(0.0000)	(0.0000)	(0.0000)

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% level. All models include controls for student's major and entry cohort. The excluded entry age group is 18-20-year-olds.

Table 7 presents the same regressions as Table 4 conditional on staying on the first four years of study, i.e. excluding dropouts. This reduces sample sizes by about 15 percent. The results are about the same for other coefficients, but the coefficient for the rank of initial points is increased in size and significance. Given that the student has not dropped out during the first years of study, high rank in initial points is positively associated with student performance. Controlling for the success in the entrance exam, the students with good grades in matriculation exam are more likely to dropout. One possible explanation for this is that students with higher grades have better academic outside options since they are more likely to get into other programs in other universities.

Table 8 presents the probability to graduate within seven years using a linear probability model. The results are in line with Table 4. Students with a high rank in the entrance exam have higher probability to graduate. The coefficient is statistically significant for social sciences, sport sciences and engineering. The rank of initial points is positive for all fields but statistically significant only for education. Female students have higher graduation probability in social sciences and engineering but lower in education. Older students have

Table 8. Linear probability to graduate in 7 years.

	Social sciences		Sport sciences		Education		Engineering	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank of entrance exam	0.480***	0.510***	0.416***	0.381**	0.124	0.136	0.304***	0.346***
	(0.161)	(0.163)	(0.158)	(0.158)	(0.220)	(0.218)	(0.047)	(0.046)
Rank of initial points	0.113	0.029	0.120	0.072	0.529***	0.539***	0.039	0.041
	(0.069)	(0.078)	(0.114)	(0.122)	(0.165)	(0.159)	(0.036)	(0.036)
Female		0.118***		-0.089		-0.459***		0.151***
		(0.046)		(0.071)		(0.153)		(0.022)
Age at entry: 21-23		-0.090**		-0.232***		-0.071		0.104***
		(0.044)		(0.074)		(0.098)		(0.024)
24-		-0.030		-0.349***		-0.231*		0.089
		(0.057)		(0.090)		(0.135)		(0.050)
Observations	687	687	244	244	133	133	3,278	3,278
R-squared	0.11	0.13	0.11	0.16	0.07	0.11	0.06	0.08
F statistic	7.72	7.58	7.13	6.08	2.76	4.96	12.40	14.75
(Prob>F)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0306)	(0.0000)	(0.0000)	(0.0000)

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% level. All models include controls for student's major and entry cohort. The excluded entry age group is 18-20-year-olds.

higher graduation probability in engineering but lower graduation probability in other fields.

6.1 Predicted effects of a change in the admission rules

The results in the previous tables show that subject-related entrance exams are better predictors of achievement in engineering, social sciences and sport sciences whether the achievement is measured as study credits after four years or as graduation. Initial points predict graduation better in the field of education. In addition, results show that senior secondary school GPA is a good predictor of success at university. However, it is hard to compare different admission systems based on these results because a large number of students would be admitted regardless of the admission rules used. Therefore, it is interesting to look at students who would be admitted using one rule but rejected using the other. Success in studies can only be observed for the students who were admitted in the current system and alternative selection rules might admit different students. However, since the admission is based on observables, the performance of the non-enrolled students can be predicted using results in Table 4. Controls are added for entrance exam and initial point

ranks, gender, three age groups, major, and entry cohort. Including higher terms of regressors does not change the qualitative results.

The first column in Table 9 presents the success of students who would have been admitted using entrance exam but rejected using initial points and the second column presents the success of students who would have been accepted using initial points but rejected using entrance exam. The difference between the first group (entrance exam) and the second group (initial points) – presented in the third column – can be seen as the difference in the average performance of the "marginal" individuals. In engineering, the difference in mean number of study credits after four years between the two groups is about 19 credits, the difference in median credits is slightly lower (15 credits). Further, a significantly higher proportion of students graduate within seven years in the first group than in the second group. For social sciences, the mean (median) number of study credits after four years is about 22 (27) credits more for the first group, and almost 51 percent of the students in the first group graduate in seven years compared to the 37 percent in the second group. In education and sport sciences, the only significant difference between the groups is the fraction of students who graduate in seven years. Students selected using entrance exams do better in sport sciences but worse in education.

The results using the "marginal" students who would only be selected using one admission rule suggest that at least in engineering and social sciences it would be better to select students with entrance exam. The interesting question for the university is how the total performance of students would change if the current system using mainly total points would be replaced by a system using either entrance exams or initial points. The performance of the non-enrolled students is predicted as above. The effect of the change in the admission rules on mean performance is estimated by regressing the number of study credits after four years on a full set of dummy variables for different combinations of admission status in the three admission systems (see figure 4) and calculating the change as a linear combination of the dummy variables. The first column in Table 10 shows the change in the mean study credits of the whole student population if the selection system is changed from total points to entrance exams. There are no statistically significant changes in the mean number of

Table 9. Success of students who will change admission status depending on which admission criteria are used.

	(1) Admitted using entrance exam, but not using initial points	(2) Admitted using initial points, but not using entrance exam	(3) Difference (1) – (2) (std error)
Engineering	(904 obs)	(904 obs)	(1,808 obs)
Number of study credits after four years			
Mean	86.4	67.7	18.694** (1.836)
Median	82.4	67.1	15.415** (1.388)
Fraction of students who graduate within 7 years	0.207	0.116	0.091** (0.014)
Social sciences	(608 obs)	(608 obs)	(1,216 obs)
Number of study credits after four years			
Mean	142.1	120.0	22.095** (1.841)
Median	146.0	119.5	26.523** (1.771)
Fraction of students who graduate within 7 years	0.508	0.366	0.142** (0.018)
Sport sciences	(164 obs)	(164 obs)	(328 obs)
Number of study credits after four years			
Mean	120.1	124.9	-4.296 (3.052)
Median	123.1	124.4	-1.793 (1.202)
Fraction of students who graduate within 7 years	0.580	0.502	0.078* (0.037)
Education	(75 obs)	(75 obs)	(150 obs)
Number of study credits after four years			
Mean	144.9	146.2	-1.273 (6.961)
Median	152.9	151.5	1.356 (5.268)
Fraction of students who graduate within 7 years	0.309	0.593	-0.133* (0.063)

The sample used includes only students who are admitted using one admission criteria, either entrance exam or initial points, but not with both admission criteria. Performance of the students who were not admitted or did not enroll is predicted using results from table 4 (including controls for gender, three age groups, starting cohort and students' major). Standard errors in the parenthesis are from a robust regression. * significant at 5 % level; ** significant at 1 % level.

study credits for any fields. The second column shows the same figures for the change from total points to initial points system. In social sciences and engineering the mean number of credits after four years would diminish if the total points system was replaced by a system based on initial points. In education the mean performance of the student population would be better if initial points were used instead of total points.

Table 10. Change in the mean number of credits after four years of the student population if admission rules were changed.

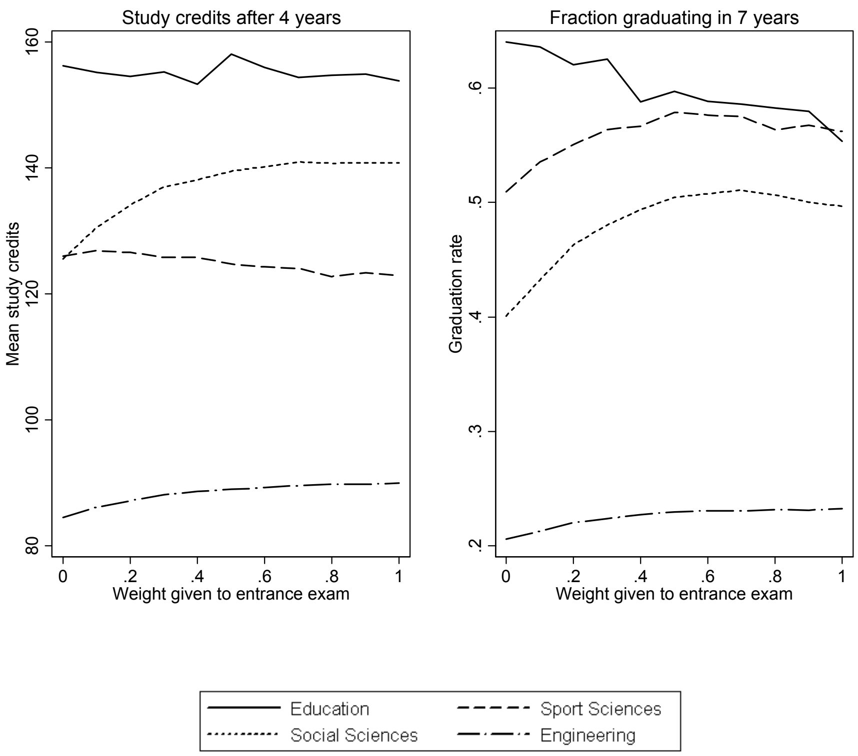
	Change from total points to entrance exam	Change from total points to initial points
Engineering		
Change in mean study credits after four years	-5.019 (9.194)	-38.784** (8.910)
Social Sciences		
Change in mean study credits after four years	10.118 (6.398)	-22.365** (5.672)
Sport Sciences		
Change in mean study credits after four years	-3.712 (12.005)	11.345 (9.996)
Education		
Change in mean study credits after four years	15.490 (14.542)	24.089** (9.074)

* significant at 5 % level; ** significant at 1 % level. Standard errors in parenthesis. The performance of the students who were not admitted or did not enroll is predicted using regression in table 3 (including controls for gender, three age groups, cohort and student's major).

The optimal admission selection rules might not be either entrance exam or initial points, but some combination of the both. However, the optimal rule does not have to weigh the both parts equally. Figure 5 plots measures of success for different student populations selected weighting the entrance exam points from zero to one. In social sciences and engineering, the mean sum of study credits after four years increases the more weight is given to entrance exams. On the other hand, in sport sciences more weight should be given to initial points and in education both parts should be weighted equally. Graduation rates are highest if entrance exams are weighed more heavily in all fields except in education.

One might be concerned that students with high matriculation exam grades have lower incentives to do as well in the entrance exams. In fact, matriculation exam grades and initial points are negatively correlated with entrance exam points in education and sport sciences (Table A2 in the Appendix). This might indicate lower incentives, but a more probable explanation is that entrance exams measure different things than school grades (e.g. physical aptitude tests in sport sciences). Most fields apply a threshold condition which requires that a student has to get a certain amount of points in the entrance exam to be admitted. In practice, these threshold points are not sufficient for admission.

Figure 5. Performance of students when admission decision is made giving different weights to the entrance exam.



Other concern is that percentile ranks of entrance exams might predict success better because the distribution of the entrance exams is different from the distribution of the initial points and there might be more variation in the entrance exam points. Figure A1 in the Appendix shows histograms of initial points and entrance exam points in each field. There are clear differences in the distributions but both initial points and entrance exam points have variation. Further, since 80 percent of the students in social sciences and engineering are admitted using total points and the remaining 20 percent are selected using only entrance exam, this last 20 percent has by definition lower initial points than the first 80 percent of the students. This might affect the coefficients of the percentile ranks. As a robustness

check, the regressions are run excluding the students who were admitted on the basis of the entrance exam only. The results do not change qualitatively.

7. Conclusion

At best, factors which can be used as admission criteria and which are observable to the admission committee at the time of the admission decision explain about 15 percent of the variation in the student achievement. The results show that initial entry points based on past performance in school are good predictors of graduation from university in the field of education. For the fields of social sciences, sport sciences and engineering, percentile ranks in entrance exams provide a better prediction for student achievement. A large fraction of students would be admitted whether the admission was based on entrance exams, initial entry points or total points, which is the sum of entrance exam and initial points. This is especially true for the field of engineering. Admitting students on the basis of their past school performance instead of total points would decrease the mean performance of the student population in engineering and social sciences but increase the mean performance in education. Using only entrance exams would not affect the mean performance in any of the fields studied. However, changing the admission rules could lead to changes in the pool of applicants and unfortunately it is not possible to estimate the effects of the change in the pool of applicants. In addition, the performance predictions of the rejected applicants are based on strong assumptions on the functional form, and the results on the effect of a change in the admission criteria should be read with that in mind.

The data in the current form include no family background variables or labor market information for the students. The future extension of this study is to match the data with registers that include information on student's family background, earnings and months of work during and after the enrollment. This will enable e.g. to study how much pre-university skills affect earnings after graduation or the effect of different admission criteria on the success in the labor market.

References

Ahola, S. (2004): Yhteishausta yhteisvalintaan. Yliopistojen opiskelijavalintojen kehittäminen. *Opetusministeriön työryhmämuistioita ja selvityksiä 2004:9.* Ministry of Education.

Betts, J. R. and D. Morell (1999): The determinants of undergraduate grade point average: the relative importance of family background, high school resources, and peer group effects. *The Journal of Human Resources 34, 268-293.*

Garam, I. and S. Ahola (2001): Suuntana tulevaisuus. Tutkimus varsinaissuomalaisten abiturienttien koulutustoiveista, -suunnitelmista sekä niiden taustalla olevista käsityksistä. *Länsi-Suomen lääninhallituksen julkaisuja 15/2001.*

Gillberg, A. (1987): Tutkimus Helsingin kauppakorkeakoulun vuosina 1977-1979 sisäänpäässeiden opiskelijoiden opintomenestykseen vaikuttaneista tekijöistä. *Helsingin kauppakorkeakoulun julkaisuja D-94.* Helsinki.

KOTA database. Administrated by the Ministry of Education, available online at http://www.csc.fi/kota/nuts.html

Krueger, A. B. and S. Wu (2000): Forecasting job placements of economics graduate students. *Journal of Economic Education 31, 81-94.*

Lindblom-Ylänne, S., K. Lonka and S. Maury (1992): Miten aineistokokeessa menestyminen ennustaa alkuvaiheen opintomenestystä. Helsingin yliopisto. Opintoasiain julkaisuja. Helsinki.

Ministry of Education (2004): Management and steering of higher education in Finland. *Publications of the Ministry of Education, Finland 2004:20.*

Rantanen, P. (2001): Valintakoe vai ei? Ammatillisen koulutuksen ja ammattikorkeakoulujen opiskelijavalinnan tarkastelua*. Koulutus- ja tiedepolitiikan osaston julkaisusarja 83.* Ministry of Education.

Rothstein, J. M. (2003): College performance predictions and the SAT. *Journal of Econometrics 121, 297-317.*

Silvennoinen, M., L. Laakso and J. Turunen (1991): Liikuntatieteellisen tiedekunnan valintakoetutkimus. Jyväskylän yliopisto. Liikuntakasvatuksen laitos A 20. Jyväskylä.

SOU (2004): Tre vägar till den öppna högskolan. Betänkande av Tillträdesutredningen. *Statens offentliga utredningar 2004:29.* Stockholm.

Öckert, B. (2001): Does pre-university background matter? In *Effects of higher education and the role of admission selection*, Dissertation series no. 52, Swedish Institute for Social Research, Stockholm University.

Appendix

Table A1. Descriptive statistics.

	Engineering					
	Admitted applicants			Non-admitted applicants		
Variable	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Female	3,391	0.196	0.397	4,366	0.185	0.388
Age at entry: 18-20	3,391	0.850	0.357	4,366	0.661	0.473
21-23	3,391	0.124	0.330	4,366	0.244	0.430
23-	3,391	0.026	0.159	4,366	0.095	0.293
Number of study credits after four years	3,391	89.1	52.9			
Rank in entrance exam	3,391	0.757	0.166	4,366	0.309	0.194
Rank in initial points	3,391	0.709	0.213	4,366	0.344	0.233
ME grade mother tongue	3,391	5.254	0.877	4,362	4.548	1.080
ME grade the other national language	3,385	5.088	1.067	4,356	4.168	1.307
ME grade foreign language	3,389	5.176	1.040	4,359	4.375	1.287
ME grade mathematics	3,387	5.581	0.693	4,290	4.546	1.181
ME grade science and humanities	1,109	5.605	0.809	1,763	4.481	1.341
Senior secondary school GPA	3,389	8.832	0.616	4,362	8.106	0.693
Cohort 1986	3,391	0.337	0.473	4,366	0.285	0.451
Cohort 1990	3,391	0.334	0.472	4,366	0.305	0.461
Cohort 1995	3,391	0.329	0.470	4,366	0.410	0.492

	Social Sciences					
	Admitted applicants			Non-admitted applicants		
Variable	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Female	881	0.620	0.486	4,671	0.601	0.490
Age at entry: 18-20	881	0.413	0.493	4,671	0.468	0.499
21-23	881	0.390	0.488	4,671	0.344	0.475
23-	881	0.196	0.397	4,671	0.188	0.391
Number of study credits after four years	881	101.6	74.8			
Rank in entrance exam	881	0.871	0.137	4,671	0.456	0.253
Rank in initial points	881	0.711	0.260	4,671	0.471	0.279
ME grade mother tongue	853	5.298	0.811	4,445	4.823	0.966
ME grade the other national language	765	4.918	1.080	4,181	4.246	1.185
ME grade foreign language	853	5.014	1.072	4,443	4.304	1.214
ME grade mathematics	720	4.601	1.256	3,421	3.986	1.403
ME grade science and humanities	809	5.190	1.024	4,265	4.611	1.190
Senior secondary school GPA	710	8.537	0.691	3,612	8.118	0.704
Cohort 1992	881	0.296	0.457	4,671	0.300	0.458
Cohort 1995	881	0.356	0.479	4,671	0.305	0.461
Cohort 1997	881	0.347	0.476	4,671	0.395	0.489

Table continues on the next page.

Table continues from the previous page.

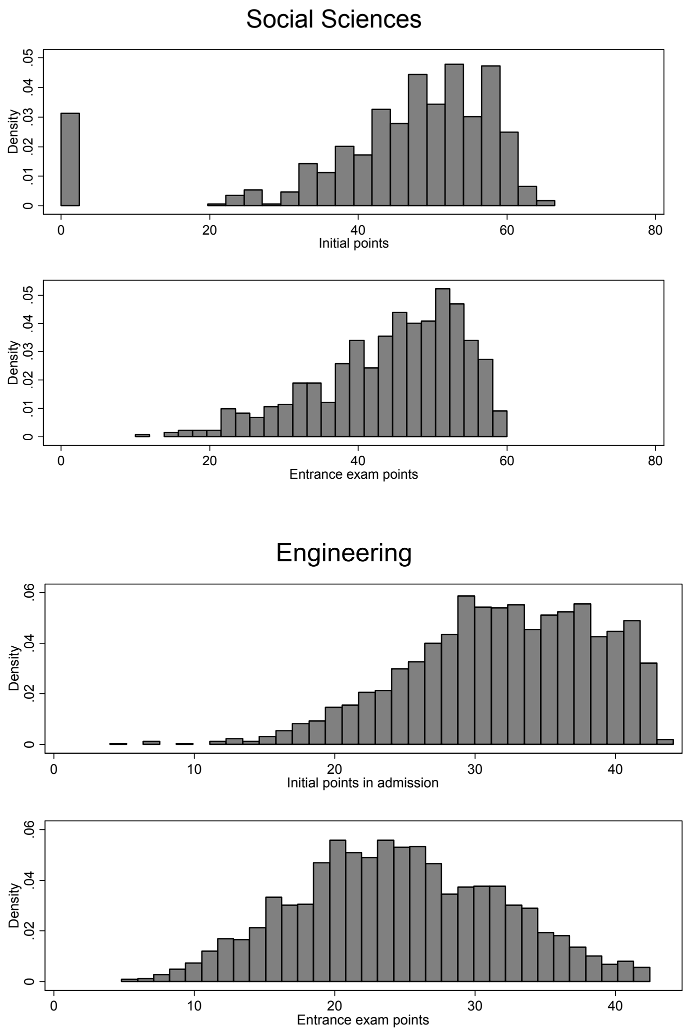
	Sport Sciences					
	Admitted applicants			Non-admitted applicants		
Variable	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Female	249	0.546	0.499	1,067	0.455	0.498
Age at entry: 18-20	249	0.367	0.484	1,067	0.608	0.488
21-23	249	0.438	0.497	1,067	0.276	0.447
23-	249	0.192	0.394	1,067	0.116	0.321
Number of study credits after four years	249	118.5	47.3			
Rank in entrance exam	249	0.768	0.221	1,067	0.419	0.263
Rank in initial points	249	0.607	0.285	1,067	0.480	0.281
ME grade mother tongue	239	4.954	0.846	1,007	4.906	0.811
ME grade the other national language	235	4.762	1.079	942	4.562	0.969
ME grade foreign language	239	4.506	1.045	1,006	4.326	1.066
ME grade mathematics	216	4.366	1.254	927	4.297	1.204
ME grade science and humanities	230	4.700	1.164	972	4.623	1.078
Senior secondary school GPA	219	8.537	0.609	859	8.444	0.535
Cohort 1992	249	0.341	0.475	1,067	0.407	0.491
Cohort 1995	249	0.309	0.463	1,067	0.303	0.460
Cohort 1997	249	0.349	0.477	1,067	0.291	0.454

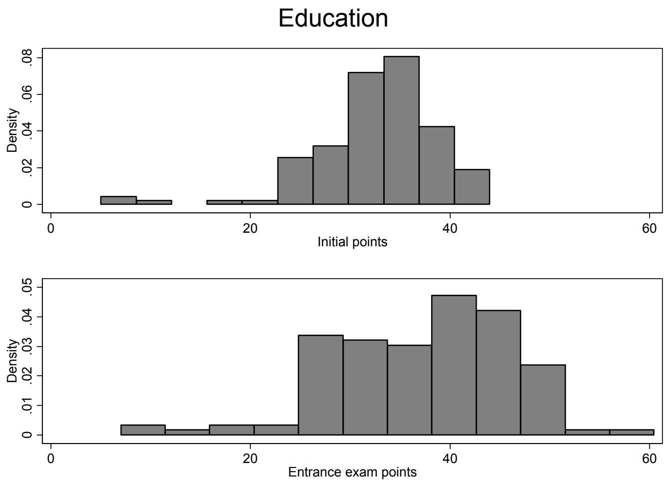
	Education					
	Admitted applicants			Non-admitted applicants		
Variable	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Female	137	0.934	0.249	438	0.863	0.344
Age at entry: 18-20	137	0.431	0.497	438	0.400	0.490
21-23	137	0.394	0.490	438	0.349	0.477
23-	137	0.175	0.382	438	0.251	0.434
Number of study credits after four years	137	141.6	57.3			
Rank in entrance exam	137	0.816	0.158	438	0.409	0.250
Rank in initial points	137	0.719	0.233	438	0.439	0.273
ME grade mother tongue	134	5.142	0.833	423	4.574	0.943
ME grade the other national language	125	4.704	0.976	419	3.924	1.138
ME grade foreign language	134	4.328	1.024	423	3.652	1.202
ME grade mathematics	107	4.243	1.373	296	3.541	1.491
ME grade science and humanities	129	5.116	0.898	407	4.199	1.121
Senior secondary school GPA	115	8.501	0.566	381	7.947	0.639
Cohort 1992	137	0.365	0.483	438	0.477	0.500
Cohort 1995	137	0.299	0.460	438	0.281	0.450
Cohort 1997	137	0.336	0.474	438	0.242	0.429

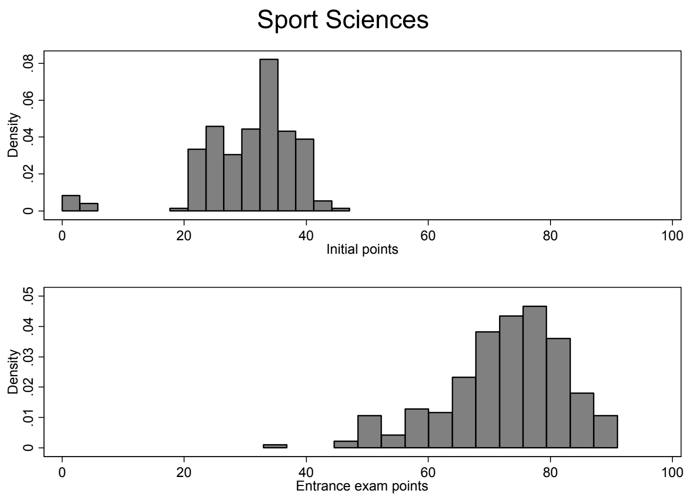
Table A2. Rank correlations of variables.

Spearman's rank correlation	ME mean grade	Mother tongue ME grade	Other national language ME grade	Foreign language ME grade	Mathe-matics ME grade	Senior secondary school GPA	Initial points	En-trance exam points
Engineering:								
Initial points	0.43	0.42	0.43	0.38	0.30	0.53		
Entrance exam points	0.29	0.16	0.15	0.17	0.37	0.24	-0.03	
Number of study credits after 4 years	0.06	0.01	0.07	-0.01	0.07	0.17	0.03	0.24
Social Sciences:								
Initial points	0.79	0.71	0.70	0.67	0.37	0.75		
Entrance exam points	0.06	0.05	0.08	-0.02	-0.06	0.03	0.08	
Number of study credits after 4 years	0.04	-0.03	0.12	-0.05	0.02	0.17	0.05	0.11
Sport Sciences:								
Initial points	0.58	0.36	0.45	0.38	0.36	0.51		
Entrance exam points	-0.09	-0.17	-0.08	-0.14	-0.01	-0.11	-0.09	
Number of study credits after 4 years	0.09	0.09	0.02	-0.09	0.08	0.22	0.19	0.11
Education:								
Initial points	0.75	0.47	0.67	0.59	0.45	0.86		
Entrance exam points	-0.33	-0.15	-0.21	-0.16	-0.001	-0.31	-0.09	
Number of study credits after 4 years	0.01	0.15	-0.03	0.02	0.06	0.14	0.14	0.17

Figure A1. Distribution of initial points and entrance exam points of admitted students by field of study.




Education
Density
0
.02
.04
.06
.08
0
20
40
60
Initial points
Density
0
.01
.02
.03
.04
.05
0
20
40
60
Entrance exam points


Sport Sciences
Density
0
.02
.04
.06
.08
0
20
40
60
80
100
Initial points
Density
0
.01
.02
.03
.04
.05
0
20
40
60
80
100
Entrance exam points

Essay III

The Effect of a Student Aid Reform on Graduation: A Duration Analysis*

1. Introduction

The long duration of the university studies has generated a lively public discussion in Finland. Critics of the current system argue that the universities are inefficient and that completing university education takes far too long. The main reason for the concern is that long study times delay the entry to the labor market. In addition to the private costs for the student and an extra burden on the university resources, late entry to the labor market also creates a considerable social cost by reducing the labor supply and increasing the dependency ratio.

The median graduation age for Finnish university students is 27.5. According to the OECD Education at a Glance (1998), this is the second highest figure in the OECD-countries. Only Danish students graduate at an older age. A partial explanation for the high graduation age in Finland is that the Finnish students begin their university studies later than elsewhere. However, this late starting age is far from being the whole story. University studies also take, on average, much longer than intended. Most university programs are designed so that they can be completed in five years. Yet, the median graduation time is much longer, 6.5 years.

* Written together with Roope Uusitalo. We are thankful for comments and suggestions from the seminar participants at LSE Center of Economics of Education, Uppsala University, Government Institute for Economic Research, IZA European summer school in labor economics, ZEW Human Capital workshop, EALE 2002 conference, and ESPE 2003 conference. Financial support from the European Commission's Research Training Network "New Techniques for the Evaluation of European Labour Market Policies" (contract no HPRN-CT-2000-00071) and Yrjö Jahnsson Foundation is gratefully acknowledged.

Several reforms that were aimed to increase the efficiency of universities were carried out in the 1990s. The most important was a reform of the student aid system. In 1992, the old loan-based student aid system was replaced with a system that relies on student grants. At the same time, the maximum duration of the student aid was reduced.

One of the main arguments for the student aid reform was that larger student grants would enable students to concentrate more on their studies, instead of dividing their time between studies and part-time work. Shorter grant duration should also improve incentives to complete the studies within the grant period. Formal target in the government action plan for higher education was that 75 percent of students should complete their master's degree in five years.

In this paper we evaluate the effect of the student aid reform on the duration of the university studies. We use large individual level panel data that follow the students from the start of their university career to the eventual graduation. The data allow us to control for a number of other factors that may influence graduation times. Particularly important are large changes in the student employment opportunities. During the period that we examine, the Finnish economy entered a severe recession. Unemployment rates increased from three to eighteen percent between 1991 and 1994. The unemployment rate for the 15–24 -year-olds was over 30 percent for three years. This increase in unemployment also reduced student part-time employment opportunities. Large changes in the economic environment can be expected to influence graduation times, no matter how the student aid system was reformed. With individual level data from different regions differing in the severity of recession, we can account for the business cycle effects on student employment, and hence on the graduation times. We can also control for a number of individual and family specific factors, as well as, differences in ability.

Previous research on the effects of financial aid on graduation times has primarily focused on the PhD programs. Ehrenberg and Mavros (1995) use data on all graduate students who entered the PhD program at Cornell University. They find that the students receiving fellowships and research assistantships have higher completion rates and shorter times-to-

degree than the students who receive teaching assistantships or tuition waivers, or the students who are totally self-supporting. Siegfried and Stock (2001) use data on PhD graduates in economics in the US. They also find that students who receive fellowships graduate faster. In contrast, Booth and Satchell (1995) find no significant effects of research council funding on the graduation times of the British PhD students. The only study on the length of undergraduate education we could find is an unpublished paper on the US four-year-college duration by van Ophem and Jonker (1999). They find that students receiving scholarships graduate faster, but argue that this might be due to their higher ability.

The rest of this paper is organized as follows. We start by a short description of the Finnish university system. This is followed by a description of the student aid system, and the reform carried out in 1992. Section 3 describes our data sources, and section 4 the methods used in the evaluation. Empirical results are presented in section 5. Section 6 concludes.

2. The Finnish university system

There are twenty universities in Finland. The largest fields are engineering, humanities, and natural sciences. Slightly more than half of the university students are female. As a result of the government policy to increase the supply of higher education, the number new entrants has grown by some 20 percent during the last ten years. The increase in supply was executed by admitting more students to the existing universities and programs. In 2001, there were about 162,800 university students, of whom 20,600 were new entrants. (KOTA database of Ministry of Education).

All universities in Finland are run by the state. Education is free, as there are no tuition fees. Universities select their students independently. Competition for the slots in higher education is fierce, and annual admission quotas apply to all fields of study. Various entrance examinations form a central part of the selection process. In 2001, only 26 percent of the applicants were admitted. The poor employment prospects in the early 1990s might

have increased the demand for higher education. The fraction admitted has remained roughly constant even though the number of slots has increased in many fields.

Most students are admitted to programs leading to a master's degree. The master's degree consists of one major and one or more minor subjects. The graduation requirement is, depending on the field of study, 160 or 180 credits. One credit corresponds roughly to one week of full-time study. For example, a typical one-semester intermediate microeconomics course would yield five credits. Most programs are designed so that the graduation requirement can be fulfilled in five years. However, students can, in principle, stay enrolled as long as they wish. No strict limits on the duration of studies are imposed.

2.1 Student financial aid reform

Before 1992, the student financial aid system was mainly based on subsidized student loans. The loans had a government guarantee and the government subsidized the interest rate fixing the rate for the students to 4.5 percent. Students also received a smaller study grant and a housing supplement, but the student loans were the cornerstone of the system. In 1991, the student grant was 640 marks (108 euro) per month, the maximum housing supplement 780 marks (131 euro) per month, and the maximum loan 1,800 marks (303 euro) per month. (Blomster, 2000).

Financial aid was granted for up to seven academic years. In order to keep receiving student aid, a student had to complete at least 15 credits during the first year and at least 20 credits during the following years. The credit requirement was not really binding: fulfilling minimum requirements yielded 135 credits in seven years, which was still 25 credits short of the graduation requirement. There were also income limits for student earnings to ensure that the aid was used to finance full-time studies. A student was allowed to earn 3,000 marks (504 euro) per month before the student aid was cut. Parental income does not affect the amount of student aid in tertiary education.

In summer 1992, the financial aid system was profoundly reformed. Government subsidies for the student loans were abolished, but the government still provided guarantee for student loans up to 1,200 marks (202 euro) per month. The interest rate of the loan is the current market rate and loans must be repaid to the full amount. The repayment of the loans starts after graduation or ten years after taking out the loan for the first time if the student has not graduated by then. The study grant was more than doubled in the reform - to 1,570 marks (264 euro) per month. Housing supplement was also slightly increased - to 884 marks (149 euro). Only minor changes to the student aid system have been carried out after 1992. Student aid is not indexed, so inflation has also decreased the real value of the student grant.

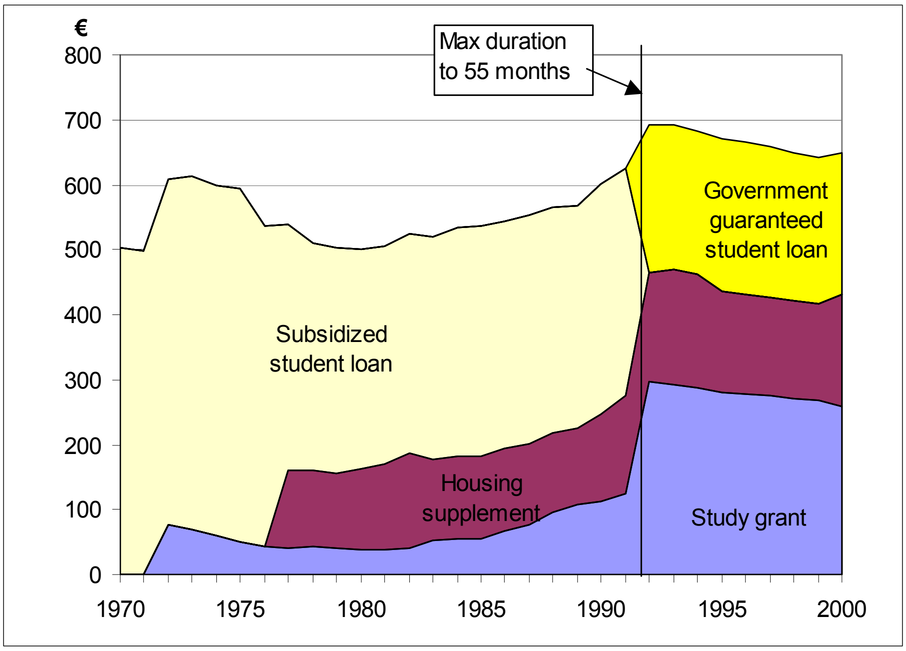
In Figure 1 we plot the real value of student aid since the creation of the student aid system in 1969. The figure shows that the 1992 reform was the largest single change in the history of the student aid. The total amount increased by some 13 percent, but more importantly the direct support, including the housing supplement, almost doubled.

Another important change that occurred in 1992 was a cut in the duration of the student aid. The maximum duration was reduced from seven years to 55 months. As the normal length of a study year is nine months (from September to May), the maximum grant duration was effectively reduced by about a year. An exception was made for students who had received aid prior to July 1992. For these students the maximum duration remained at seven years.

An important argument for the student aid reform was to make studying more effective by distributing more financial aid at a faster rate[1]. However, the system has not functioned as planned. Removing the interest subsidy from the student loans made loans unpopular. Before 1992, roughly half of the students took out a loan. After the reform this fraction was less than a third (Raivola et al., 2000). Rather than taking out the loan with market interest rate, many students have preferred to add to their income by working. According to a recent

[1] The attempt to reduce times-to-degree was not the only reason for reforming the system. Due to the rising market interest rates, the banks had become unwilling to grant student loans that, even with the government interest rate subsidy, paid less than the market rate.

Figure 1. Maximum amount of student financial aid in Finland 1970-2000 (€/month).



In 2000 prices (euro) deflated by the cost of living index.

study on the students at the University of Helsinki, 75 percent of students worked during the semester 2000-2001 (Härkönen, 2001). Consistent time series on student employment is difficult to create, but the calculations by Häkkinen (2004) indicate that student employment has risen rapidly after 1993. The increase is partially explained by the general recovery from the recession.

Expected effects of the student aid reform are not clear-cut. The higher study grant lowers the cost of studying, making it possible for the students to stay longer at universities. On the other hand, the higher study grant also enables students to concentrate on their studies instead of working. This could shorten the graduation times. Cutting the maximum aid period from seven years to 55 months should encourage students to graduate faster.

3. Data

We use data from the Employment Statistics (ES) of Statistics Finland. The data cover the whole population, and contain information on individual income, employment, education, household composition etc. The ES data cover years from 1987 to 1999. The ES data combine information from approximately 30 official registers. For our purposes, the two most important source registers are the Student Register and the Register on Completed Education and Degrees. The Student Register records enrollment at the universities at the beginning of each term. The Register on Completed Education and Degrees contains the level and the field of achieved degrees and the date of their completion.

In this study, we use a research database that the Statistics Finland has created by drawing a random sample of 350,000 individuals, aged between 12 and 74 in 1990, from the ES data. This sample is representative, and includes approximately eight percent of the population in the relevant age. The research database is a balanced panel: the individuals in the data are followed from 1987 to 1999. Completed degrees are also available from the year 2000.

From the ES sample, we select all students whose first university enrollment year was between 1987 and 1995. For these students, we collect information on each student's secondary school graduation date, the first and the last university enrollment date, the name of the university where enrolled, the field of study, the university graduation date, and the degree achieved (if the student had graduated by August 2000). In addition, we record the student's gender, age, marital status, presence of children, months in employment and total annual earnings. For the time-variant variables, these data are collected for each year the student has been enrolled. In addition, we use the full ES sample to calculate measures of employment prospects for each field because poor employment figures might prolong the graduation. More precisely, we use the unemployment rate of the graduates from the same field during the past five years to capture the graduation incentives.

In the ES data the students can be linked to their parents. We were able to obtain data on the parents' income and education for most students. To reduce the effect of measurement

error, we add up the income of both parents and calculate the average over three years, following the year of entry to the university. We also have information on secondary school grades, but only for those students who finished secondary school after 1990. We use the mean score of the four compulsory exams to measure the overall success in the matriculation examination. As the parents' data and the matriculation examination results are available for only a part of the students, we calculate all estimates for both the full sample and the smaller sample with complete data.

We added information specific to the field of study and the location of the university from two additional sources. We used the KOTA database of the Ministry of Education to calculate student-teacher ratios by program and by university. We calculated this by dividing the total number of enrolled students in the program by the total man-years of the teaching faculty. We also used the KOTA database to obtain information on the median duration of completed degrees in each field. Information on local labor market conditions was available from the regional database of the Statistics Finland (ALTIKA). We obtained the municipality-level unemployment rates for each year at each university location from this database, and matched this information to the students at the corresponding universities.

The graduation date is recorded in months. In principle, the students may graduate at any time during the academic year. This is reflected in the graduation dates that are rather dispersed in the data, even though there are clear peaks in May and December. We measure the duration of studies as the number of months starting from September of the first enrolment year. For the students who have not achieved a degree by our last observation date (August 2000), we mark the durations as censored at this point. Some of these students are dropouts, but some still continue their studies. To maintain consistency across different student cohorts, we also measure all other incomplete spells up to the time of the last enrolment date. So if a student started in September 1990, never graduated, and was last enrolled in the fall term of 1994, we record this spell as being censored in September 1994. The duration of this incomplete spell is, therefore, 48 months.

We cannot identify dropouts. It is impossible to make a distinction between active students and "hang-around" students, who are enrolled at a university but have no intention to finish and should, therefore, be considered as dropouts[2]. Because we cannot distinguish between inactive and active students, we consider all non-graduates who registered themselves as "present" in a given year, as students continuing their studies.

4. Methods

A natural way of modeling times-to-degree is a duration model. The duration model specifies the graduation hazard as a function of exogenous covariates. The main advantages of the duration model, compared to the regression framework, are that right-censored observations can be handled in a straightforward way, and that time-variant covariates can be introduced without conceptual problems.

The graduation hazard, i.e. the probability of graduating after *t* months of study, given that the student is still enrolled, is

$$\lambda_t = \phi(x, \beta)\lambda_0(t), \qquad (1)$$

where x is an observed vector of covariates, β a vector of estimated parameters, and $\lambda_0(t)$ the baseline hazard. To make the baseline hazard as flexible as possible, we choose piecewise constant specification assuming that the hazard is constant for each 12 month interval, but place no restrictions on the changes in the hazard between these intervals.

Recorded spells can end due to graduation, dropout, or censoring at the last observation date. In principle, it is possible to estimate a competing risks model, and analyze separately the factors that affect the graduation and the dropout hazards. Because identifying the dropouts from active students is not possible in our data, we focus on graduates, effectively

[2] Students receive discounts e.g. for public transport. As the registration costs are low, it is often beneficial to register as a student, even if one has no plans to take part in any courses or examinations. According to other studies, about 15 percent of the students are not studying actively (Vesikansa et al., 1998).

treating the dropouts as censored at the point where they were last enrolled, which in most cases is the last year of the observation period.

We also need to account for the unobserved heterogeneity among the students. As time passes, students who put more effort in their studies graduate faster and the sample becomes increasingly composed of "lazier" students. To allow for this, we make a simple parametric assumption that unobserved heterogeneity follows a Gamma distribution and enters the hazard function multiplicatively[3].

Inclusion of time-variant covariates in the model creates a problem that is more severe than what is usually encountered in the hazard models. In the standard model, a change in a covariate may have an immediate effect on the hazard rate. Our case is more complicated since the effects are likely to involve considerable lags. For example, more lucrative work opportunities at the boom of the business cycle may draw students to the labor market, and delay their graduation. The effect on the graduation times cannot be seen until the students actually graduate several years later. This could already be during an economic downturn. Graduation hazards are, therefore, a function of not only current but also past values of the exogenous variables.

Another problem with the time-variant covariates is that they are by construction endogenous. For example, the amount of student aid is meaningfully defined only until the student graduates. Also the student aid reform can only influence the older cohorts if they stay at the university until the reform date. The observed time path of the covariates, therefore, depends on the spell duration[4]. We solve this endogeneity problem by replacing the time-varying covariates by their averages over the first four years of study[5]. We calculate this

---

[3] Another possibility for modeling unobserved heterogeneity would assume that there are discrete types of students, as in van Ours and Ridder (2003). This could be specified so that it allows correlation across completion and dropout hazards. Because we cannot identify dropouts in any reliable way the choice of the functional form for the unobserved heterogeneity appears less important and we choose Gamma distribution for its simplicity.

[4] Kalbfeisch and Prentice (1980) refer to covariates that are defined only until the termination of a spell as internal.

[5] The time-varying variables are children, female*children, married, student-teacher ratio, local unemployment rate, unemployment rate of the study field, and study field dummies.

average for each student, irrespective of whether she is still enrolled or not. This way the observed covariate path is independent of the spell duration. This approach also makes the graduation hazard a function of not just the current, but also the past values of the covariates. Our results could also be interpreted as the effect of an average exposure to some covariate values during the first four years[6].

5. Empirical results

5.1 Descriptive analysis

The Ministry of Education follows the duration of university studies by tabulating the median duration of the completed degrees. We begin our analysis by calculating the same statistic for our sample, and present the numbers in Table 1. The results show that the median duration of completed degrees has slightly declined over time, but is still almost six years in 2000. The average length of complete spells is higher and more volatile, reflecting the influence of a few very long durations.

The change in the median length of the completed spells tells little about the changes in the duration of university education. First, possible changes in the dropout rates influence the numbers. Second, an increase in the inflow of new students increases the fraction of short, on-going spells, and creates a downward trend in the length of the completed spells. Finally, any policy change that would increase graduation hazards of those with long on-going durations, would generate a temporary increase in the average length of the completed spells.

A better statistic is the median length of completed degrees by the year of entry. We present this at the lower part of Table 1. The median is calculated for the whole entry cohort, effectively defining the dropouts as not yet graduated. Also the median duration by the year of

[6] Another possibility would be to assume that the graduation hazard is a function of the cumulative average of the covariate values up to the graduation date. This could be a better measure of the average exposure, particularly for those with long spells, but cumulative average is not exogenous with respect to the spell duration.

Table 1. Times-to-degree.

Median and average duration of completed degrees 1987-2000

Graduation year	1987	1988	1989	1990	1991	1992	1993
Median duration (months)	79	75	77	77	74	74	74
Average duration (months)	86	93	84	89	79	81	81

Graduation year	1994	1995	1996	1997	1998	1999	2000
Median duration (months)	74	74	73	74	74	74	71
Average duration (months)	80	77	81	82	83	85	83

Median duration of completed degrees by the year of entry

Entry year	1987	1988	1989	1990	1991	1992	1993
Median duration (months)	90	92	87	89	92	87	86

entry shows that the graduation times have become slightly shorter. The median has declined by four months from 1987 to 1993. Interestingly, the cohorts that entered after the student aid reform (1992 and 1993) have the shortest median times-to-degree. We do not know whether the declining trend continues in the later cohorts, because the median student from the 1994 entry cohort did not graduate by the end of our observation period.

The slight decline in the median duration may, of course, be due to other factors than the student aid reform. The student composition has changed because of an increase in admissions. Also the changes in the labor market opportunities and in the distribution of students across fields may influence the median graduation times. We will try to isolate these effects in the next section. Before that, it is useful to examine the distribution of graduation in more detail.

Figure 2 plots the Kaplan-Meyer survival functions in the five largest fields: education, business, engineering, natural sciences, and humanities. Variation across the fields is, indeed, substantial. Half of the students in teacher education, but less than ten percent of the students in humanities, graduate in five years. The median graduation time in humanities is almost eight years. Survival rates are also high in natural sciences and engineering.

Figure 2. Kaplan-Meier survival estimates by study field.

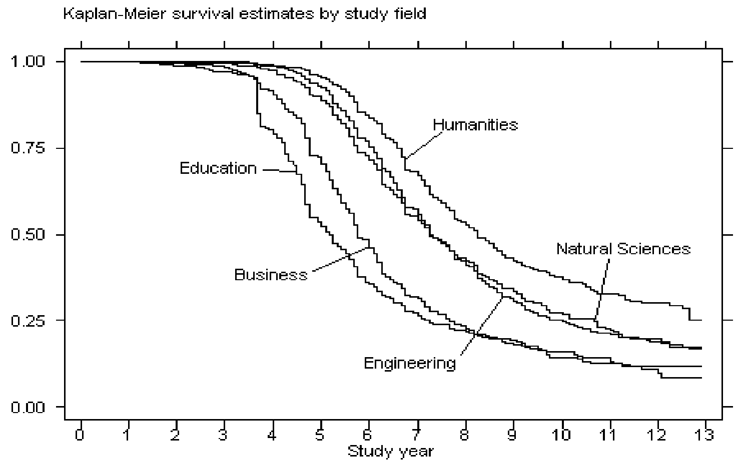
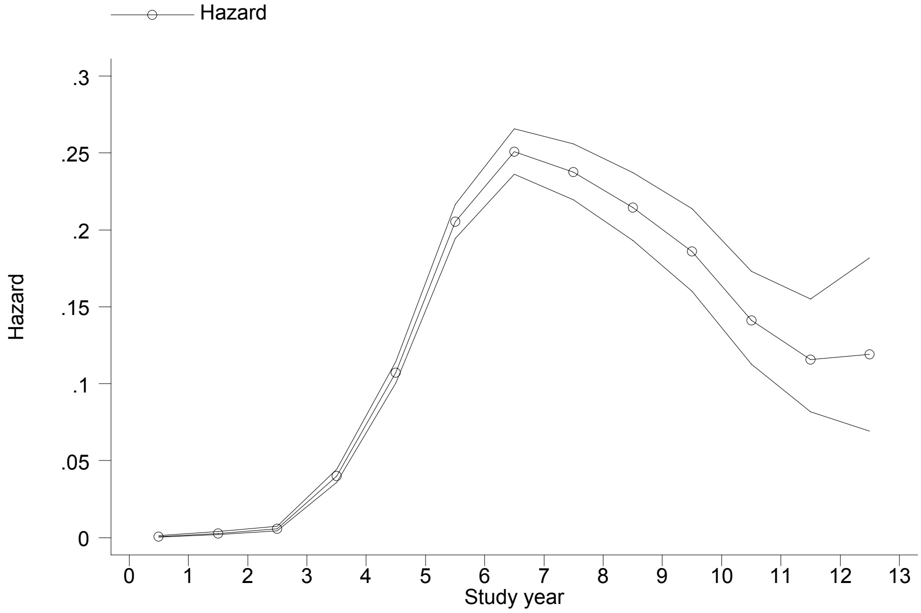


Figure 3 plots the empirical hazard rate for the whole sample. It is immediately obvious that the hazard is highly non-monotonous. The estimated hazard of graduation is almost zero for the first three years.[7] It then increases rapidly until the seventh study year. If a student is still enrolled after seven years, the conditional probability of graduating starts to decrease. A likely explanation for the non-monotonous hazard function is heterogeneity across individuals. Those who are left after seven years are those who had lower graduation hazards to begin with. A full life table behind the hazard function estimates is presented in Table 2. In addition to displaying the hazard rate, the table shows that half of the students graduate within seven years, and 83 percent during the 13-year observation period. The mode in the graduation times is between five and six years, but there are a substantial number of students who graduate later than seven years after entering university. The fraction of the censored observations is rather high, particularly after the fifth year. This is mainly due to the incomplete spells at the last observation date.

[7] Most observations with times-to-degree less than two years probably involve some studies in open university or abroad before the official entry date, but this could not be observed in the data. On the other hand, graduating in two years is quite possible, though uncommon.

Figure3. Empirical hazard rate.



Note: To estimate the empirical hazard the data have been split into 12 month intervals. The estimated hazard rate is the number of graduates during the year divided by the population at risk at the beginning of the year. The lines around the hazard indicate the 95% confidence intervals.

Table 2. Life table.

Study Year	Population at risk	Censored	Graduates	Hazard	Cumulative Graduation
0-1	9,403	110	5	0.0005	0.0005
1-2	9,288	130	25	0.0027	0.0032
2-3	9,133	277	52	0.0057	0.0089
3-4	8,804	153	351	0.0399	0.0484
4-5	8,300	973	889	0.1071	0.1503
5-6	6,438	732	1,321	0.2052	0.3247
6-7	4,385	531	1,099	0.2506	0.4939
7-8	2,755	418	654	0.2374	0.6141
8-9	1,683	327	361	0.2145	0.6968
9-10	995	222	185	0.1859	0.7532
10-11	588	176	83	0.1412	0.7880
11-12	329	148	38	0.1155	0.8125
12-13	143	126	17	0.1189	0.8348

5.2 Duration model

First we estimate a duration model with dummy variables for each entry cohort. To capture the differences across the study fields, we also add twenty dummy variables indicating the field of study. The other included covariates are gender, presence of children, interaction of the presence of children and the gender, marital status, language group, age at entry, student-teacher -ratio, and an indicator if the student has changed field of study during the first four years. As described in the previous section, we estimate the model with piece-wise constant baseline hazard and Gamma frailty. The results are presented as hazard ratios; coefficients greater than one indicate that the covariate increases the graduation hazard.

In the interest of saving space, we do not report the coefficients of the field dummies. However, we should point out that differences across fields are large, even after accounting for the student composition. Graduation hazards are particularly low in humanities, natural sciences, music, theology, and arts. Graduation hazards are highest in education, business, law, and health care. Other coefficient estimates are in Table 3. We find that older, married, and female students have higher completion hazards. The presence of children does not have a statistically significant effect; the point estimates suggest that the effect could be negative for women. Swedish speakers have lower graduation hazards. A higher student-teacher ratio lowers the graduation hazard. Estimates at the bottom of the table indicate that there is substantial unobserved heterogeneity across students.

The year dummies in column 1 show an interesting pattern. The coefficients for the entry year dummies for 1988-1991 are not significantly different from the omitted category, 1987. In contrast, all the coefficients for 1992-1995 are significant, and roughly equal in size. The result indicates that, all else equal, the cohorts that entered after the student aid reform in 1992 have significantly higher graduation hazards.

In column 2, we replace the entry cohort dummies with a reform dummy that equals one for the post 1992 entry cohorts. The post 1992 dummy is significant, and shows that the graduation hazards are higher for the students who entered under the reformed student aid

system. As the model in column 2 is nested in the model of column 1, we can test for the parameter restrictions. The hypothesis that the time pattern is adequately described by the post 1992 dummy only, is not rejected (p-value = 0.62).

In column 3, we add unemployment rates to the model. To capture the student employment opportunities, we measure the unemployment rate at each university location. We also try to account for the graduation incentives by inserting to the model the unemployment rate of recent graduates in the same field of study. We find that higher local unemployment rate significantly increases the graduation hazard. In contrast, the unemployment rate among the recent graduates has a negative, though not statistically significant, effect. Local unemployment rate remains significant even if entry year dummies are included and the effect of local unemployment is identified from differences in the changes of unemployment across different university locations (not reported in the table). After adding the labor market variables, the coefficient of the post 1992 dummy declines, and is no longer significant. Our interpretation of this result is that shorter graduation times for the post-reform entry cohorts are fully explained by higher unemployment that decreased employment opportunities. Another interesting observation is that the effect of the student-teacher ratio is robust to changes in specification. Higher student-teacher ratio lowers the graduation hazard in all specifications.

The results do not change in column 4 where we include ability measures and parents income. A higher score in the matriculation exam increases the graduation hazard, but has little influence on the other coefficients. Also parents' income has a small, but insignificant positive effect on the graduation hazards.

Table3. Determinants of the graduation hazard.

	(1)	(2)	(3)	(4)
Age at the beginning of studies	1.07	1.07	1.07	1.08
	(5.72)**	(5.74)**	(5.56)**	(1.80)
Female	1.50	1.50	1.51	1.61
	(5.32)**	(5.39)**	(5.48)**	(5.08)**
Female*children	0.54	0.52	0.54	0.17
	(1.47)	(1.55)	(1.46)	(1.62)
Children	1.02	1.05	0.99	1.77
	(0.06)	(0.13)	(0.02)	(0.60)
Married	3.41	3.34	3.35	2.98
	(5.97)**	(5.91)**	(5.96)**	(3.06)**
Swedish speaking	0.64	0.64	0.69	0.80
	(3.50)**	(3.40)**	(2.93)**	(1.51)
Changed study field	0.33	0.33	0.34	0.38
	(8.87)**	(8.86)**	(8.67)**	(7.12)**
Students-teacher –ratio	0.49	0.51	0.52	0.56
	(5.92)**	(5.85)**	(5.64)**	(3.70)**
Starting year 88	0.81			
	(1.48)			
Starting year 89	0.95			
	(0.37)			
Starting year 90	0.92			
	(0.59)			
Starting year 91	1.03			
	(0.18)			
Starting year 92	1.35			
	(2.04)*			
Starting year 93	1.39			
	(2.21)*			
Starting year 94	1.59			
	(3.01)**			
Starting year 95	1.57			
	(2.67)**			
Post92		1.53	1.11	0.91
		(5.58)**	(0.93)	(0.68)
Local unemployment rate			1.04	1.08
			(3.85)**	(5.48)**
Unemployment rate of the study field			0.98	0.95
			(1.45)	(1.54)

Table 3 continues on the next page.

Table 3 continues from the previous page.

	(1)	(2)	(3)	(4)
Mean score in Matriculation Examination				1.27
				(4.07)**
Parents' income 2nd quartile				1.13
				(0.51)
Parents' income 3rd quartile				1.39
				(1.43)
Parents' income 4th quartile				1.20
				(0.81)
Variance of unobs. Heterogeneity (σ^2)	0.46	0.46	0.45	0.28
	(26.98)**	(27.23)**	(27.02)**	(16.20)**
Observations	61,579	61,579	61,579	28,113
LogL	-4,055.34	-4,058.01	-4,049.93	-1,444.80
Number of Students	9,350	9,350	9,350	4,600
Number of Graduates	5,042	5,042	5,042	2,038

The reported coefficients are hazard ratios. Absolute value of z-statistics in parentheses. * indicates statistical significance at the 5% level; ** significance at 1% level. All models are based on the piece-wise constant baseline hazard and are estimated with the Gamma frailty. All equations also include 20 dummy variables indicating the field of study.

The fundamental identification problem in evaluating the effects of the student aid reform is the lack of cross-sectional variation in the student aid system. Simply including the unemployment rate may not be sufficient to control for the different labor market situation faced by the different entry cohorts. More convincing evidence on the effects of the student aid reform can be found by examining the differences in the changes of the graduation hazards across different groups of students. It can be argued that, even though the change in the student aid was similar in all groups, the reform could have stronger effects in some groups than others. For example, the students with less wealthy parents are probably more dependent on the student aid. The effect of the reform should, therefore, be larger for the students from poor families. Also the effect of restricting the duration of student aid should be stronger in the fields where the average graduation times are longer.

We test these ideas by re-estimating the model interacting the reform dummy with the parents' income and the average study duration of the field. We create a dummy variable "Poor parents" equal to one if the parents' income is in the lowest quartile, and add it to the

model interacted with the reform dummy[8]. Similarly, we define a dummy that equals one if the average graduation time in the field exceeds the maximum duration of the student aid.

Table 4 presents the results of the models with the interaction terms. As before, we first present the results without the labor market measures in column 1, add the unemployment rates in column 2, and re-estimate the model with the smaller sample that contains the matriculation exam results in column 3. The results indicate that the interactions between parents' income and post 1992 dummy are small and insignificant. In contrast, the interaction between the average study time and the reform dummy is positive and significant. The student aid reform appears to have shortened the graduation times in the fields where graduation times are long. The threat effect of the student aid running out seems responsible for the slight decrease in the graduation times.

[8] We experimented with different measures of parental income but these did not change the results much. Choosing the lowest quartile for the interactions is motivated by the results in Table 3 which show that the lowest quartile has slightly lower hazard rates, but there is little difference between the other quartiles. It should also be noted that the quartiles are calculated from the sample used in the estimations and refers to the lowest quartile among the parents of the university students, not to the lowest quartile in population.

Table 4. Piecewise linear estimates with interaction terms.

	(1)	(2)	(3)
Age at the beginning of studies	1.02	1.01	1.10
	(0.80)	(0.35)	(2.00)*
Female	1.47	1.48	1.61
	(5.31)**	(5.53)**	(5.03)**
Female*children	0.28	0.30	0.18
	(2.68)**	(2.60)**	(1.59)
Children	1.72	1.64	1.70
	(1.23)	(1.15)	(0.55)
Married	3.05	2.95	3.04
	(5.17)**	(5.13)**	(3.12)**
Swedish speaking	0.67	0.73	0.80
	(3.32)**	(2.65)**	(1.48)
Changed study field	0.34	0.36	0.37
	(8.66)**	(8.41)**	(7.19)**
Students/teachers	0.51	0.53	0.58
	(6.00)**	(5.63)**	(3.52)**
Post92	1.14	0.72	0.78
	(1.14)	(2.29)*	(1.26)
Long study-times*post92	1.55	1.75	1.41
	(3.13)**	(3.88)**	(1.60)
Poor parents	0.88	0.85	1.12
	(1.24)	(1.67)	(0.61)
Poor parents*Post92	1.13	1.16	0.84
	(0.83)	(1.02)	(0.82)
Local unemployment rate		1.06	1.08
		(5.40)**	(5.53)**
Unemployment rate of the study field		0.95	0.93
		(2.85)**	(2.48)*
Mean score in Matriculation Examination			1.26
			(4.02)**
Variance of unobs. heterogeneity (σ^2)	0.42	0.40	0.29
	(22.50)**	(22.06)**	(16.51)**
Observations	59,776	59,776	28,113
LogL	-3,763.14	-3,748.56	-1,444.35
Number of Students	9,044	9,044	4,600
Number of Graduates	4,910	4,910	2,038

The reported coefficients are hazard ratios. Absolute value of z-statistics in parentheses. * indicates statistical significance at the 5% level; ** significance at 1% level. All models are based on the piece-wise constant baseline hazard and are estimated with the Gamma frailty. All equations also include 20 dummy variables indicating the field of study. The number of observations differs from table 3 because parental information and matriculation examination scores were not available for all students.

6. Conclusion

Median duration of university studies in Finland currently exceeds the planned duration by one and a half years. Considerable efficiency gains could be achieved if the students accumulated same amount of knowledge in five years than what they currently do in six or seven years. The difficult question is whether there are feasible policy options that would shorten the graduation times.

Our results indicate that the student aid reform had only a modest effect on the graduation times. The effect was concentrated in the fields with long average duration. This suggests that the limits in the aid duration were more important than a switch from the loan-based to the grant-based system. However, the most important reason for the slight decline in the times-to-degree appears to be the increase in unemployment that decreased student employment opportunities. Unfortunately, the large changes in the unemployment make the evaluation of the effect of the student aid reform that occurred at the onset of recession difficult, and our results should be read with that in mind.

Changing the parameters of the student aid system is not the only policy option for the government aiming to produce more graduates at a faster rate. Our results indicate that an increase in the university resources could have a considerable effect. Lowering the student-teacher ratio increases the graduation hazards. However, this policy could be rather expensive, and it is not clear whether the benefits of shorter graduation times would be sufficient to cover the increase in the expenditure.

References

Blomster, P. (2000): Yliopisto-opiskelijoiden toimeentulo ja opintotuki 1900-luvun Suomessa. *KELA sosiaali- ja terveysturvan tutkimuksia 56*.

Booth, A. L., and S. E. Satchell (1995): The hazards of doing a PhD: an analysis of completion and withdrawal rates of British PhD students in the 1980s. *Journal of the Royal Statistical Society, Series A (Statistics in Society) 158(2)*, 297-318.

Ehrenberg, R. G., and P. G. Mavros (1995): Do doctoral students' financial support patterns affect their times-to-degree and completion probabilities. *Journal of Human Resources 30(3)*, 581-609.

Häkkinen, I. (2004): Working while enrolled in a university: Does it pay. *Working paper 2004:1, Department of Economics, Uppsala University*.

Härkönen, H. (2001): Opiskelijan rahapussilla. Selvitys Helsingin yliopiston opiskelijoiden toimeentulosta ja asumisesta keväällä 2001. Helsinki, Helsingin yliopiston ylioppilaskunta.

Kalbfleisch, J. D. and R. L. Prentice (1980): The statistical analysis of failure time data. John Wiley and Sons.

OECD (1998): Education at a glance. OECD indicators 1998, Paris, OECD.

Van Ophem, H., & N. Jonker (1999): The duration of higher education: semiparametric estimation of a dependent risks model, mimeo, University of Amsterdam.

Siegfried, J., and W. Stock (2001): So you want to earn a Ph.D. in economics? How long do you think it will take? *The Journal of Human Resources 36*, 364-378.

Raivola, R., M. Zechner and J. Vehviläinen (2000): Opintotuki - opiskelijapalkka vai koulutusinvestointi, Helsinki, Ministry of Education 14/2000.

Van Ours, J.C. and G. Ridder (2003): Fast track or failure: a study of the graduation and dropout rates of PhD students in economics. *Economics of Education Review 22*, 157 – 166.

Vesikansa, S., P. Lempinen and S. Suomela (1998): Tehokkaaseen opiskeluun – Norminopeutta vai mielekästä oppimista. *Otus rs 14/1998.*

Appendix

Table A1. Descriptive statistics.

Variable	All students		Graduates	
	Obs	Mean	Obs	Mean
Female	9,403	0.54	5,080	0.56
Children	9,403	0.05	5,080	0.04
Married	9,398	0.08	5,075	0.07
Unemployment rate of graduates in field	9,403	7.35	5,080	6,34
Local unemployment rate	9,403	13.58	5,080	12.23
Swedish speaking	9,386	0.08	5,069	0.07
Age at the beginning of studies	9,403	21.23	5,080	20.91
Changed study field during the first four years	9,403	0.09	5,080	0.09
Parents' income	9,090	51,644	4,942	52,387
Mean score in Matriculation Examination	4,638	5.08	2,058	5.15
Student-teacher ratio	9,372	19.27	5,058	18.37
Median graduation time	9,403	6.64	5,080	6.51
Humanities	9,403	0.167	5,080	0.127
Theology	9,403	0.014	5,080	0.012
Industrial Arts	9,403	0.009	5,080	0.008
Music	9,403	0.010	5,080	0.007
Theatre	9,403	0.003	5,080	0.005
Visual Arts	9,403	0.001	5,080	0.001
Physical Education	9,403	0.005	5,080	0.008
Social Sciences	9,403	0.095	5,080	0.089
Psychology	9,403	0.010	5,080	0.011
Healthcare	9,403	0.003	5,080	0.004
Dentistry	9,403	0.007	5,080	0.012
Veterinary	9,403	0.004	5,080	0.005
Law	9,403	0.034	5,080	0.039
Business	9,403	0.095	5,080	0.121
Natural Sciences	9,403	0.156	5,080	0.138
Pharmacy	9,403	0.021	5,080	0.009
Agriculture and Forestry	9,403	0.022	5,080	0.022
Engineering	9,403	0.191	5,080	0.194
Medicine	9,403	0.032	5,080	0.046
Education	9,403	0.119	5,080	0.140
Started studies during the new system	9,403	0.46	5,080	0.58
Entry year 87	9,403	0.106	5,080	0.141
Entry year 88	9,403	0.108	5,080	0.137
Entry year 89	9,403	0.110	5,080	0.145
Entry year 90	9,403	0.108	5,080	0.139
Entry year 91	9,403	0.111	5,080	0.123
Entry year 92	9,403	0.111	5,080	0.115
Entry year 93	9,403	0.114	5,080	0.101
Entry year 94	9,403	0.111	5,080	0.065
Entry year 95	9,403	0.121	5,080	0.034

Essay IV

Working While Enrolled in a University: Does it Pay?*

1. Introduction

Working while studying is everyday life for a substantial proportion of European university students. The fraction of students in employment varies from 48 percent in France to 77 percent in the Netherlands. On average, European working students spend 11 hours per week in paid employment and receive between 31 and 54 percent of their total income from employment (Euro Student, 2000). Finland is no exception what comes to student employment. Roughly half of the Finnish students work while enrolled in a university. Students who work spend about 20 hours a week in employment and cover about half of their living expenses by income from employment.

Students are a noteworthy part of the labor force, and student employment is a highly debated issue because of the gains and losses it generates for the individuals as well as the society. From the society's point of view, students provide a flexible reserve for labor. Student workers often work part-time and can adjust their working hours to the current labor market situation. Students tend to increase their labor supply during the economic booms when jobs are easier to find, and reduce working during the downturns when the labor markets slacken.

* I thank Per-Anders Edin, Tuulia Hakola, Oskar Nordström Skans, Mårten Palme, Roope Uusitalo, and the seminar participants at Uppsala University, University of Helsinki, Aarhus School of Business, Labour Institute for Economic Research in Helsinki, and the ESPE 2004 conference for helpful comments. This essay is produced as a part of the Research Training Network "New Techniques for the Evaluation of European Labour Market Policies", funded by the European Commission (contract no HPRN-CT-2000-00071). Additional financial support from Yrjö Jahnsson foundation and the Finnish Cultural Foundation is gratefully acknowledged.

An individual may choose to enter the labor market prior to graduation for several reasons. Many students are dependent on the extra income, but employment may also be a chance to invest in income-enhancing skills that are not provided at university. Work experience in the field of study may complement the formal education and improve study motivation. Student workers might also improve their job search and interpersonal skills, get familiarized with the world of work and gain sense of responsibility, all of which are valuable skills also in their later career. Potential future employers might regard work experience as a signal for other attributes, e.g. high motivation and ability, and labor market contacts improve employment opportunities after graduation. In most fields of study, university education does not prepare students for one specific job and therefore appropriate work experience may be essential for finding a job after graduation. In a survey on students at the University of Helsinki, labor market contacts were reported as the most important reason for working during the enrollment, and 42 percent of those who worked had a job related to the study field (Härkönen, 2001).

Student employment has also negative effects. There is a time-use trade-off between working and studying. Students engaged in working use considerably less time on their studies. Finnish university students who do not work use 35 hours per week on study-related activities, whereas working students use only 19 hours per week on studying (Lempinen and Tiilikainen, 2001). Work during the semesters may interfere with learning and academic performance, and may even encourage students to drop out. If the length of enrollment in the university is not restricted, working usually leads to longer times-to-degree.

The times-to-degree in Finland have shortened slightly in the 1990s, but the median completion time of a Master's degree is still more than one year longer than the target duration. Häkkinen and Uusitalo (2003) found that working is one of the main reasons for prolonged studies and the decrease in times-to-degree is mainly due to the higher unemployment that decreased students' employment opportunities. Long times-to-degree create an extra burden on the university resources and private costs for the students. Students' part-time employment also decreases the total labor supply because long times-to-degree shorten the career after graduation.

The essential question is whether the gains from working are larger than the distortion effect it has on achievement at university and on study time. This study estimates the return to in-school work experience at the beginning of the post-graduate working career using a rich panel data set of about 3,900 individuals. The data are constructed from the Employment Statistics of Statistics Finland and include students from 1987-1995 university entry cohorts. Individuals in the data are followed from the first enrollment to 1998. The results show that all OLS models predict positive returns to working. However, the amount of work students choose is not exogenous. Local unemployment rate during the enrollment is used as an instrument for the work experience acquisition. Using IV and comparing graduates with equal times-to-degree, the study finds that working yields a considerable increase in earnings one year after graduation, and the effect is positive but smaller and statistically insignificant in the later years. In IV models which take into account that working increases the times-to-degree, the effect of work experience on earnings is much lower and statistically insignificant for all years. There are no statistically significant effects on employment if instrumental variable technique is used.

The rest of the paper is organized as follows. Section 2 provides a summary of previous literature on the returns to in-school work. Section 3 describes the data set used. The features of student employment in Finland are presented in Section 4. The econometric methods are described in Section 5. Section 6 provides the estimation results and Section 7 concludes.

2. Previous literature

Ruhm (1997) provides a thorough survey of the effects of working during school on subsequent labor market outcome. Most of this literature considers the effects of high school employment and typically finds that work in high school is associated with higher future earnings. However, it is important to examine whether these estimated effects are causal or simply spurious correlations. Many of these studies do not adequately (or at all) control for the potential endogeneity of the work decision or the number of hours worked. The esti-

mated effects might merely reflect the persistent role of unobservable differences in ability or preferences that influence both the likelihood of working in high school and the later success in labor market. This could explain why many studies have found very persistent returns to in-school work even though the returns should diminish as individuals get more experience in the graduate labor market.

Less research has been done on the effects of working during higher education even though working is more common at an older age and work experience acquired near the entry to the graduates' labor market is probably more important factor determining the success in the later career than early work experience. Light (2001) attempts to separate the effects of schooling and in-school work experience on post-school wages and finds that men who accumulate work experience while in school begin their post-school careers earning 10 - 18 percent more than their counterparts who gain no in-school work experience. Hotz et al. (2002) study the effects of working while in high school or college on subsequent wages of men by estimating a dynamic discrete choice model. Hotz et al. find that including a relatively rich set of background conditions and indicators of labor market conditions in wage equations reproduces the positive effects of working while in school on subsequent wages found in previous studies. However, the effects are diminished in magnitude and statistical significance once the unobserved heterogeneity is taken into account using a random effects specification.

There are also a few studies that have looked on how working affects academic performance or the quality of jobs after graduation. Paul (1982) and Stinebrickner and Stinebrickner (2003) find that working is detrimental to academic performance in college, Hood et al. (1992) find that grade point averages are highest among students with moderate amounts of work, and Ehrenberg and Sherman (1987) find positive effects of working in on-campus jobs but negative effects of working in off-campus jobs. Häkkinen and Uusitalo (2003) studied the student financial aid reform and the changes in times-to-degree in Finland and found that working has a negative effect on graduation. Hämäläinen (2003) states that in-school work experience may have a non-linear effect on the quality of employment after graduation. Her results show that Finnish university graduates with moderate amounts of

in-school work experience in the field of study have jobs that match their education, but having more than 33 months of in-school work experience in the field has a negative impact on the job match. Time-to-degree or number of credits achieved at the university has no effect on the quality of employment in the study of Hämäläinen (2003).

In contrast to the previous studies that have used representative cohort data, this paper concentrates on the employment decisions of the university students. This is a restrictive sampling decision, but it is still very interesting to look at the working behavior and returns of the individuals given that they have decided to pursue university studies. The vast majority of previous studies, including Light (2001) and Hotz et al. (2002), have considered the return of in-school work experience for men. Since more than half of the university students in Finland are female, studying only the effects of working for men is not justified. In addition, most of the previous studies do not control for the field of study. The amount of work experience the student is able to acquire during the enrollment depends on the field of study because the employment possibilities are not uniform across the fields and the organization of the course work affects the possibility of working during the academic year. More importantly, labor market prospects after graduation vary enormously across the fields. There is strong empirical evidence that graduates from the more professionally oriented disciplines, such as engineering and business, tend to have consistently higher than average earnings.[1] If the field of study is not controlled for, the returns to student employment might be driven by the field specific labor market characteristics rather than real returns.

3. Data

The study uses data from the Employment Statistics (ES) of Statistics Finland. The ES cover the whole population and contain information on individual income, employment, education, household composition etc. All data in the ES are register based. This study uses a research database that the Statistics Finland has created by drawing a random sample of

[1] For empirical results on the economic returns to college major, see e.g. Rumberger and Thomas (1993) and Finnie and Frenette (2003).

350,000 individuals, aged between 12 and 74 in 1990, from the ES. This sample is representative and includes approximately eight percent of the population in the relevant age. The research database is a panel and individuals in the data are followed from 1987 to 1998.

For this study, all university students who started their studies between 1987 and 1995 are selected from the ES sample. The study concentrates on university students because other students cannot be identified from the ES data but also because university students are more interesting in the sense that their working decisions are not affected by restrictions on the length of enrollment as in secondary and non-university tertiary education. 1987 is the first university entry cohort for whom the work experience during the enrollment can be calculated from the ES data. The data include labor market outcomes of 3,700 graduates.

Excluding dropouts from the analysis and concentrating on graduates might be sensible because the labor markets of graduates and dropouts are different, and thus, dropouts are a poor comparison group to graduates. However, a student with a good job that does not require a completed degree may not graduate at all or working may affect the timing of the graduation. Therefore, this study examines also the labor market outcome of the entire entry cohort, regardless of the graduation status, eight and ten years after the first enrollment year. Eight years after the first enrollment year, these models are based on the entry cohorts of 1987-1990 (roughly 3,900 individuals). Ten years after the first enrollment year, these models are based on the entry cohorts of 1987 and 1988 (roughly 1,900 individuals).

Information is collected on each student's months of employment, total annual earnings, enrollment information, name of the university where enrolled, field of study, graduation date, and the degree achieved. In addition, student's gender, age, marital status, presence of children, and area of residence are recorded. For the time-variant variables, data are collected for each year between 1987 and 1998. Data on the parents' income and education are available for most of the students. The incomes of both parents are added up. To decrease the measurement error, parents' average income during the first three study years is used.

Information on local labor market conditions was available from the regional database of Statistics Finland (ALTIKA). Municipality-level unemployment rates, income per inhabitant, number of jobs, and regional industrial mix for each year at each university location are obtained from this database and matched to the students at the corresponding universities. Local unemployment rates after the graduation refer to the area where the graduate is living on the last day of the observation year.

Work experience variable is the sum of months worked during the enrollment converted into years of experience. Enrollment is defined as the period from the university entry to graduation. Students whose initial education in the first enrollment year is higher than upper secondary education are excluded from the sample. The work experience acquired before the university studies cannot be controlled for, but after controlling for age and excluding individuals with prior tertiary level education this should be a minor problem.

In the source register, working is recorded as the number of work months during the calendar year and, thus, it is impossible to distinguish work during the terms and work during summer vacations or other holidays. There is no information on the quality of the job or any employer information in the data. Further, it is not possible to make a distinction between part-time employment and full employment or control the number of hours worked. This is particularly problematic when looking at student employment because many students work part-time or have shorter than one-month's employment spells. There are some irregularities in the registered work months. For example, short-time LEL-insured[2] employment contracts are categorically marked to last for one month, irrespective of their actual duration (Hakola 2002, p. 29). This means that if a student has worked for two days, this can be registered as one month's work. Students of different fields may work in different sectors and part-time employment or short employment spells are not necessarily registered uniformly between different sectors in the ES. To some extent, this can be controlled for by including dummies for the field of study in the estimated equations. However, measurement errors lead to overestimation of the actual work months. The classic result is that

[2] LEL stands for temporary employees' pension act.

the OLS estimate of a mismeasured regressor is downward biased.[3] This is taken into account in the estimation by using instrumental variable technique discussed in Section 5. Descriptive statistics of the data set are presented in the Appendix in Table A1.

4. Student employment in Finland

Most of the students selected for universities are admitted to courses leading to a Master's degree, which consists of 160-180 credits including a major and one or more minor subjects. Education is free, as there are no tuition fees. Most programs are designed so that it is possible to graduate in five years. However, students can, in principle, stay enrolled as long as they wish. The median time-to-degree in Master's programs is slightly more than six years.

Students are entitled to financial aid. Prior to 1992, the student financial aid system was mainly based on subsidized student loans. In 1992, the system was profoundly reformed.[4] Government subsidies on loans were abolished, but the amount of direct aid, the study grant, was more than doubled. The maximum amount of study grant and housing supplement after the reform was about 400 euro per month and the maximum amount of student loan (with market interest rate) was nearly 220 euro per month. The maximum duration of student aid was reduced from seven years to 55 months, which was an effective reduction of about one year since the length of a study year is nine months (from September to May). In order to keep receiving student aid, a student has to progress in studies and get 2.5 credits per aid month. However, the credit requirement is not really binding: fulfilling minimum requirements yields 137.5 credits during the maximum aid period, which is still 22.5 credits short of the graduation requirement. Similar credit requirement was in effect also before the 1992 reform.

---

[3] See e.g. Green (2000) or Hausman (2001) for a discussion on the direction of bias caused by badly measured regressors.

[4] For a more detailed description of the student aid reform, see Häkkinen and Uusitalo (2003).

Removing the interest subsidy made the student loans unpopular. The interest rates of the student loans rose from 4.5 percent to about 9 percent when the interest rate subsidy was abolished. Before the reform, roughly half of the students took out a loan but after 1992 this fraction was less than a third. Rather than taking out the loan, most students have preferred to add to their income by working. There are income limits for student earnings to ensure that the aid is used to finance full-time studies. A student is allowed to earn 505 euro per aid month before the aid is cut. Parental income does not affect the amount of student aid at tertiary level.

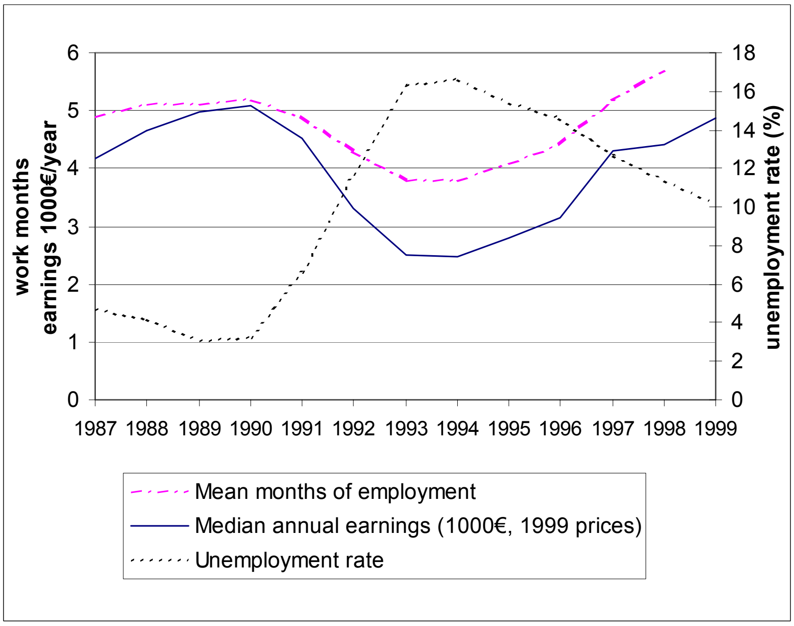
It is possible to combine work and studies since no strict limits on the duration of studies are imposed. Roughly 50 percent of the university students work, most of them part-time. Students' employment decisions are clearly affected by the availability of student jobs. Working is more common in the Helsinki capital area where there are more student jobs available. According to a recent survey on the students at the University of Helsinki, 75 percent of students worked during the semester 2000-2001 (Härkönen, 2001). In smaller towns student jobs are hard to find and jobs are more seldom related to the student's field of study. There is also considerable time-variation in working during the studies (Figure 1). Both students' earnings and months of employment decreased substantially as the unemployment rate increased in the early 1990s. The student employment increased again as the economy recovered from the recession.

Before discussing the effects of student work on labor market outcomes, it is instructive to look at the determinants of the decision to work while enrolled. Student's months of employment can be written as

$$E_{iut} = \alpha_t + \beta X_{it} + \gamma U_{ut} + \varepsilon_{iut} , \qquad (1)$$

where E is the number of months worked; X is a vector of individual characteristics, e.g. age, gender, family background and field of study; and U is a vector of labor market characteristics, e.g. the availability of student jobs at the university location. Index i refers to individual, u to university location and t to time. To get a representative picture of em-

Figure 1. Unemployment rate, students' annual earnings and months of employment in 1987-1999.



ployment decision among the enrolled students in Finland, equation (1) is estimated using the ES database without restricting the first enrollment year to 1987. Thus, this sample differs from the entry cohorts sample used in the rest of the paper.

Random effects panel regression estimates are presented in Table 1[5]. The results show that older and female students without children work more during the studies. Women with children work less but having children increases work months for men. The local unemployment rate at each university location is included in the estimation to capture the student employment opportunities. High unemployment significantly decreases the student employment. Working also increases with study years. Students who have been enrolled for more than seven years work more than any other class. In the estimations also first year

[5] Both fixed effects model and random effects tobit model produce estimates that are very close to random effects estimates.

students (the base category) seem to work a lot, but this is mainly because the months of employment are recorded by calendar year and many first year students have been working before entering the university at the beginning of the academic year in September.

In the interest of saving space, the coefficients of the field and year dummies are not reported in the table. However, it should be pointed out that differences across fields are large, even after accounting for the student composition. Working is most common in engineering, healthcare, business, and pharmacy. Students in medicine, dentistry, veterinary, and theology work the least. There is considerable time variation in student employment. During the severe recession at the beginning of the 1990s student employment decreased. After 1992 student employment has increased considerably even if the local unemployment rate is controlled for. In addition to the changes in the labor market, also the changes in the student aid reform may have affected the employment decisions (see Häkkinen and Uusitalo, 2003). Especially the loosening of the income limits of the student financial aid and high interest rates of the student loans could have drawn more students to the labor market. However, very large simultaneous changes in the unemployment rates make the evaluation of the effects of the student aid reform difficult.

In column 2, information on parents' income and university location dummies are added to the model. Results suggest that students with parents whose income is in the lowest quartile[6] work less than other students. One explanation for this could be that students with poorer parents do not have the same contact network in the labor market as students with wealthier parents. This might also suggest that the need of extra income to cover the costs of living is not the only motivation for student employment, although the differences in the working behavior of students with different family background are not very large.

University town dummies are not reported in the table, but students in Helsinki work more than students elsewhere, even when the unemployment rate and the study field are

[6] The quartiles are calculated from the sample used in the estimation and refer to the lowest quartile among the parents of the university students, not to the lowest quartile in population. Experiments using different measures of parental income did not change the results significantly.

Table 1. Determinants of student employment. Random effects panel estimates.

Dependent variable: Months of employment	(1)	(2)
Local unemployment rate	-0.164	-0.228
	(0.008)**	(0.022)**
2nd study year (base group 1st study year)	-0.348	-0.359
	(0.045)**	(0.053)**
3rd study year	-0.381	-0.423
	(0.048)**	(0.060)**
4th study year	-0.439	-0.445
	(0.053)**	(0.071)**
5th study year	-0.344	-0.451
	(0.060)**	(0.084)**
6th study year	-0.153	-0.309
	(0.067)*	(0.098)**
7th study year	0.015	-0.232
	(0.076)	(0.114)*
> 7th study year	0.386	0.058
	(0.083)**	(0.132)
Age	0.904	1.019
	(0.030)**	(0.047)**
Age2	-0.010	-0.012
	(0.000)**	(0.001)**
In military service	-1.054	-0.878
	(0.177)**	(0.220)**
Female	0.227	0.260
	(0.053)**	(0.066)**
Female*children	-2.596	-2.728
	(0.111)**	(0.149)**
Children	0.368	0.298
	(0.086)**	(0.116)*
Parents' income below 25th percentile	-	-0.157
		(0.071)*
Field of study dummies	Yes	Yes
Year dummies	Yes	Yes
University town dummies	No	Yes
Number of observations	78,454	50,971
Number of students	17,547	9,344

Standard errors in parentheses. * significant at 5%; ** significant at 1%. Sample used is a representative random sample of all Finnish university students. The number of observations in this table is larger than in the other tables because entry year is not restricted in this sample.

controlled for. Costs of living, especially cost of housing, are higher in Helsinki than in other university locations, but the housing supplement and the study grant are the same regardless of the place of residence. Diversified economic structure and large labor market in Helsinki also provide more job opportunities for students. The estimates in column 2 are based on a smaller sample because the parental information was not available for all students.

5. Econometric methods

The traditional models of human capital investment like Ben-Porath (1967) or Becker (1962) do not consider working during the enrollment as an investment in human capital. However, one can assume that students allocate their time between acquiring formal education at university and job skills at work. The same person-specific factors that influence the traditional school vs. work decision also affect the decision to combine studies and working, and the model including the in-school work experience is basically the same as the traditional Mincer (1974) earnings model. Light (2001) and Hotz et al. (2002) use the same kind of approach in their studies.

Besides the effect on wages, acquired in-school work experience may play an important role in getting the first job after graduation. Those with work experience may get more steady jobs or avoid searching for employment by staying with the same employer as prior to graduation. Merely looking at the earnings of the employed may not give the right picture of the effects if the in-school work experience has a large effect on employment probability after graduation. Therefore, graduate employment probability models are estimated. The true employment probability is nonlinear but accounting for the endogeneity of the work experience in a nonlinear model is problematic because nonlinear second-stage estimates of continuous or multivalued regressors require a correctly specified functional form in order to be interpreted easily.[7] Since we are only interested in the net effect of a change in work experience on the probability of being employed, linear models can be thought of as reasonable approximation of the true nonlinear model. The linear probability to be employed is given by

$$Employed_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 S_{it} + \beta_3 U_{ut} + \beta_4 D_i + \delta EXP_i + \varepsilon_{itu} \qquad (2)$$

where *Employed* is a binary variable indicating if the individual was employed for at least six months in the observation year; X is a vector of individual characteristics; S is the years

[7] See Angrist and Krueger (2001).

of schooling; U is the local unemployment rate; D is a set of dummy variables for the field of study; EXP is the accumulated work experience during the studies; and ε is the disturbance term. Index i refers to the individual, t refers to time, and u refers to location.

The earnings model is a modified version of the traditional Mincer equation.

$$\ln W_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 S_{it} + \beta_3 U_{ut} + \beta_4 D_i + \beta_5 \ln M_{it} + \delta EXP_i + \varepsilon_{itu}, \quad (3)$$

where W is annual wage earnings; M is the number of work months during the observation year; and other variables are as in equation (2). The earnings equation estimates are conditional on working, i.e. graduates who are unemployed or outside the labor force are excluded from the earnings equations. 65 percent of the graduates work at least six months and 44 percent of the graduates work 12 months during the year following the graduation. Two and three years from the graduation two thirds of the graduates are employed at least half a year and more than half of the graduates work full 12 months.

Since all individuals studied are university graduates with equal amount of schooling (Master's degree), the years of schooling variable can be dropped from the estimations. At the time of observation, 1-3 years after graduation, the current employment status is highly correlated with the work experience acquired after graduation. Thus, work experience after graduation is not controlled for in the equations.[8] Because the data does not include monthly wages, the study uses the natural logarithm of annual earnings as the dependent variable and includes the logarithm of work months in the explanatory variables.[9] Monthly wages could be calculated from the data, but this would be a more restrictive approach.[10] The in-school work experience is the sum of months worked during the enrollment divided by 12, which gives the total work experience in years.

[8] Including work experience after graduation diminishes the OLS coefficients slightly but the IV estimates are unchanged. The work experience after graduation is not statistically significant in the IV models.

[9] Thus, theoretically, the coefficient of logarithm of work months should be equal to one. However, monthly wages can be correlated with work months and also the measurement error affects the coefficient.

[10] However, using monthly wages as the dependent variable results in identical coefficient estimates and only slightly different standard errors.

The effect of the accumulated work experience should diminish when graduates get more experience in the labor market. Therefore, employment and earnings equations are estimated separately one, two and three years following the graduation year. The month of graduation is added into the explanatory variables, because students who have graduated at the beginning of the year have had more time to look for a job and have potentially more post-graduate work experience one year after graduation than those who have graduated at the end of the year.

In the light of the results in Table 1, it is clearly not random who works and who does not work while studying at university. In addition to student's ability and preferences, local employment possibilities and labor market conditions during the studies define whether a student enters the labor market prior to graduation. Simply looking at returns to work experience without correcting for the selection would yield biased estimates. If the students who benefit more from the work experience or the students with higher unobserved ability work more during the enrollment, the selection would bias the OLS estimates upwards. On the other hand, the measurement error in the work months will bias the OLS estimates downwards and thus, the total bias is ambiguous. To diminish the selection bias and the measurement error bias in in-school work experience, this study uses instrumental variable technique.[11]

An instrumental variable must be correlated with the included endogenous variable(s) and it must be orthogonal to the error term. The data include a set of regional variables, local unemployment rate, number of jobs per capita, income per capita and regional industry mix, which measure the local student employment opportunities and which should be uncorrelated with the outcome variables. However, these regional variables are highly correlated with each other (correlations between 0.47 and 0.84) and including more than one instrument does not increase the R^2 of the first-stage. Thus, the set of regional variables cannot be used as instruments simultaneously without running into problems with multicollinearity.

[11] Previous studies have added controls for ability and family background to diminish the endogeneity and selection bias (e.g., Ruhm, 1997). Light (2001) uses also unemployment rate, percent of urban population and median per capita family income as instruments for in-school work experience.

When these regional variables are used as instruments separately, they yield very similar results. The presented results use the local unemployment rate because it captures the employment opportunities and changes in the local labor market reasonably well, and, of the regional variables, unemployment rate has most variation in time and across the regions.

Students who studied in the late 1980s had very good job opportunities during the enrollment compared to students enrolled in the mid 1990s. Taking the extreme as an example, in Helsinki the unemployment rate at the end of the 1980s was less than 2 percent whereas the unemployment rate in Rovaniemi was about 8 percent. Due to the recession in the early 1990s, the unemployment rate had climbed up to 18 percent in Helsinki and up to 26 percent in Rovaniemi in 1995.

The unemployment rate at the university location during the studies has a strong negative effect on students' work months. The F-test of significance of the instrument shows that the local unemployment rate during the studies is a strong instrument in all estimated models. The orthogonality assumption is satisfied if the unemployment rate at the university location during the studies does not have a direct effect on employment status or annual earnings after graduation. This assumption cannot be tested without having more valid instruments, but it should hold provided that the local unemployment rate after graduation is controlled for. IV models do not include controls for the universities because some universities only provide education in one field and therefore field of study dummies partly define the university. The first-stage estimates of the IV models one year after graduation are presented in the Appendix in Table A2. The first-stage results two and three years after graduation are very similar (not presented in the table).

6. Results

The main question of interest is how the work experience acquired during the studies affects employment and earnings after graduation. Linear employment probability models and earnings equations at different points in time are estimated for graduates using OLS

and IV. To check the robustness of the results, same models are estimated for the entire entry cohort rather than just the graduates.

Since working is likely to affect the study intensity and thus, the timing of graduation, the models are estimated both with and without controlling for the elapsed time-to-degree. The interpretation of the coefficient of the work experience is different in these two specifications. Controlling for the time-to-degree, we measure the return to work experience given that the time-to-degree is not affected by working. This would be reasonable if a student only worked during the holidays. When the time-to-degree is not controlled for, the coefficient of the work experience can be interpreted as a joint effect of investing in job skills and prolonging the studies. This specification is more intuitive if we are interested in the distortion effect of working. For the employment probabilities these two specifications give very similar results, but the returns to working measured as earnings are much lower when the time-to-degree is not controlled for. In the interest of saving space, only the estimates of in-school work in different models are reported in the tables.

6.1 Employment probability

Table 2 presents the estimates of the effect of in-school work experience on employment one, two, and three years after the graduation. The dependent variable is one if the individual has worked at least six months and zero otherwise.[12] OLS estimates show that acquired in-school work experience has a positive but decreasing effect on employment probability after graduation.[13] The effect of in-school work experience diminishes over time when graduates get more post-graduate experience and more permanent jobs. Keeping everything else equal, one additional year of in-school work experience increases the probability to be

[12] Because of the measurement errors in the work months, there are some observations with at least six work months but zero income. Therefore, individuals who earn less than 3,000 euro per year are not defined as employed.

[13] Estimated marginal effects (calculated at means) of a standard probit model are slightly higher than the OLS estimates, but qualitatively probit models are very similar to OLS models. The mean predicted employment probability is about 70 percent.

employed one year after graduation by 5.6 percentage points. The effect is 4.2 percentage points two years and 3.7 percentage points three years after graduation.

Instrumental variable technique is used in order to assess the importance of endogeneity and measurement errors. The instrument used in the IV models is the local unemployment rate during the enrollment. The point estimates of the work experience are smaller in the IV models, but the coefficient is not precisely estimated and it is not statistically significant. The Hausman test is performed to check the exogeneity of work experience acquired during the enrollment. Because the standard errors in the IV models are much larger than in the OLS models and the coefficient is not statistically significant, the Hausman test could not reject the null hypothesis that all covariates are exogenous and that OLS is a consistent estimator for the employment probability equation (p-values from 0.16 to 0.88).

Working might affect the timing of the graduation or lead to dropping out. Also, students may postpone their graduation until they get a job to avoid becoming unemployed because employers may treat unemployment spells as a negative signal of the graduate's ability. Therefore, in Table 3, the employment probabilities are estimated for the entire entry cohort rather than just the graduates. The models are estimated eight and ten years after the entry to the university. 34 percent of the students have not completed their Master's degree within ten years. Ten years from the first enrollment year, graduates have on average 2.2 years of in-school work experience and 2.8 years of work experience after graduation. Non-graduates, on the other hand, have acquired 5.6 years of work experience in ten years. Thus, graduates have on average seven months less work experience than those who have not graduated in ten years.

Models with and without a dummy variable for graduates are estimated, but the results in Table 3 are not sensitive to this change in the specification. In the OLS models, eight years after the first enrollment year, one additional year of work experience increases the employment probability by about 10 percentage points. Ten years after starting the university studies, the effect of undergraduate work experience is about 8 percentage points. The point estimate of the undergraduate work experience drops into half when using the IV model

Table 2. The effect of working during the enrollment on employment.

	Including only graduates	Coefficient of years of work while enrolled		
	Dependent variable: Employed at least 6 months	1 year after graduation	2 years after graduation	3 years after graduation
(1)	Control for the time-to-degree:			
	OLS	0.056	0.042	0.037
		(0.006)**	(0.007)**	(0.009)**
	IV	0.045	-0.002	0.050
		(0.049)	(0.063)	(0.066)
	Hausman statistic	0.04	0.43	0.03
	(p-value)	(0.84)	(0.51)	(0.86)
(2)	No control for the time-to-degree:			
	OLS	0.051	0.040	0.037
		(0.006)**	(0.006)**	(0.009)**
	IV	0.027	0.015	0.042
		(0.017)	(0.022)	(0.030)
	Hausman statistic	1.98	1.24	0.02
	(p-value)	(0.16)	(0.26)	(0.88)
	Sample size	2,984	2,299	1,617

Robust standard errors in parentheses. * significant at 5%; ** significant at 1%. The other included variables are local unemployment rate, graduation month, age, female, female*children, married, a set of dummy variables for the field of study and graduation year. The instrument in the IV models is the mean local unemployment rate during the enrollment.

Table 3. The effect of working during the enrollment on employment. Robustness checks using all students 8 and 10 years after entry to the university.

	Including all individuals	Coefficient of years of work while enrolled	
	Dependent variable: Employed at least 6 months	8 years from the start	10 years from the start
(1)	Control for graduates:		
	OLS	0.096	0.074
		(0.003)**	(0.004)**
	IV	0.035	0.047
		(0.041)	(0.034)
	Hausman statistic	2.31	0.57
	(p-value)	(0.13)	(0.45)
(2)	No control for graduates:		
	OLS	0.101	0.079
		(0.003)**	(0.003)**
	IV	0.051	0.047
		(0.034)	(0.034)
	Hausman statistic	2.14	0.85
	(p-value)	(0.14)	(0.36)
	Sample size	3,935	1,930

Robust standard errors in parentheses. * significant at 5%; ** significant at 1%. The other included variables are local unemployment rate, work experience after graduation, age, female, female*children, married, a set of dummy variables for the field of study, and the first enrollment year. The instrument in the IV models is the mean local unemployment rate during the enrollment.

and the coefficient is not statistically significant. Working during the enrollment has higher effect on employment when the estimates are based on the entire entry cohort instead of restricting the analysis to graduates.

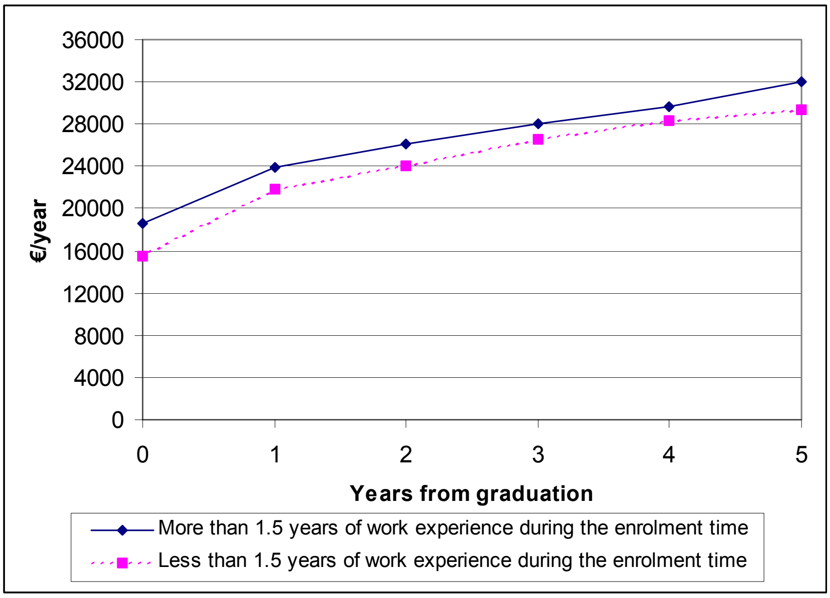
Control variable estimates (not reported in the tables) are very similar in all model specifications. As expected, results show that high local unemployment rate decreases the employment probability. Older graduates have slightly higher employment probabilities and presence of children decreases the employment probability for women. Marital status does not have a significant effect on employment. There are large differences in employment probabilities between the fields of study. Graduates in the fields of engineering, medicine, law and business have the highest employment probabilities whereas humanities, theology, teacher education and psychology have the lowest. The time-to-degree does not have a significant effect on the employment probability in the models estimated using graduates.

6.2 Earnings equations

Figure 2 shows earnings profiles for graduates with more than 1.5 years of work experience during the enrollment and graduates with less experience. Graduates with more work experience earn about 9 percent more one year after the graduation. The difference in earnings seems to be quite persistent and it is still 8.8 percent five years from the graduation. However, looking at the raw data one cannot rule out that these observed differences in earnings simply reflect preexisting differences among individuals and a sorting process rather than real returns from work experience.

The dependent variable in the earnings equations is the logarithm of total annual earnings in each year and the estimations are restricted to individuals who are employed (using the same definition of employment as in Section 6.1). Table 4 presents the effect of in-school work experience on earnings for graduates one, two, and three years after graduation. Controlling for the time-to-degree, OLS estimates on earnings show that one additional year of in-school work experience gives 3.1 percent higher earnings one year after graduation. The work experience has a positive effect of about same magnitude on earnings for all three

Figure 2. Annual earnings after graduation by acquired in-school work experience.



years after graduation. The effect of working on earnings is lower, about two percent, when time-to-degree is not controlled for. Adding university dummies or dummies for the university location into OLS models do not change the coefficients of any variables and these dummies are mostly statistically insignificant.

IV earnings models estimate a considerably higher return to in-school work experience than OLS models if the time-to-degree is controlled for. The IV estimates show that a student who works about three years during the enrollment gets 17.9 percent higher earnings one year after graduation than a student who has two years of in-school work experience. There is a decreasing trend in the IV estimates, but they remain higher than OLS estimates for all years. However, IV estimates are not statistically significant after the first year. The Hausman test rejects the OLS for the first year after graduation, but in later years when the IV estimates are not statistically significant, the Hausman test cannot reject the OLS model.

Table 4. The effect of working during the enrollment on earnings.

	Including only graduates	Coefficient of years of work while enrolled		
	Dependent variable: annual earnings	1 year after graduation	2 years after graduation	3 years after graduation
(1)	Control for the time-to-degree:			
	OLS	0.031	0.022	0.030
		(0.007)**	(0.008)**	(0.010)**
	IV	0.179	0.103	0.06
		(0.067)**	(0.086)	(0.091)
	Hausman statistic	6.10	0.81	0.10
	(p-value)	(0.01)	(0.37)	(0.75)
(2)	No control for the time-to-degree:			
	OLS	0.024	0.019	0.022
		(0.006)**	(0.008)**	(0.009)**
	IV	0.029	0.018	-0.013
		(0.017)	(0.024)	(0.036)
	Hausman statistic	0.08	0.00	0.80
	(p-value)	(0.77)	(0.97)	(0.37)
	Sample size	1,937	1,527	1,077

Robust standard errors in parentheses. * significant at 5%; ** significant at 1%. The included variables are ln(months of employment), local unemployment rate, graduation month, age, female, female*children, married, a set of dummy variables for the field of study and graduation year. The instrument in the IV models is the mean local unemployment rate during the enrollment.

If the time-to-degree variable is excluded from the IV model, the point estimates of in-school work experience become smaller, about three percent one year after graduation and two percent two years after graduation, which are fairly close to the OLS estimates without the control for time-to-degree. None of the IV estimates are statistically significant when time-to-degree is excluded and the Hausman test cannot reject OLS model.

Robustness checks using the data for the entire entry cohort (graduates and dropouts) are presented in Table 5. Including a control for graduates, OLS estimates show that in-school work experience increases earnings by 4.4 percent eight years and by 3.0 percent ten years after the entry to the university. Dropping the dummy variable for graduates decreases the OLS estimates. IV estimates (including a dummy for graduates) show that eight years after the first enrollment year the return to in-school work experience is 14.7 percent. Ten years after the university entry the point estimate of in-school work is 0.07, but the estimate is not statistically significant. Dropping the dummy variable for graduates decreases the point estimates for in-school work experience in the IV models and the estimates are not statistically significant. The estimates eight years after the first enrollment year are based on four

Table 5. The effect of working during the enrollment on earnings: robustness checks using all students 8 and 10 years after entry to the university.

	Including all individuals	Coefficient of years of work while enrolled	
	Dependent variable: annual earnings	8 years from the start	10 years from the start
(1)	Control for graduates:		
	OLS	0.044	0.030
		(0.006)**	(0.007)**
	IV	0.147	0.071
		(0.063)*	(0.094)
	Hausman statistic	3.52	0.18
	(p-value)	(0.06)	(0.67)
(2)	No control for graduates:		
	OLS	0.032	0.023
		(0.006)**	(0.007)**
	IV	0.059	0.021
		(0.036)	(0.039)
	Hausman statistic	0.64	0.00
	(p-value)	(0.42)	(0.96)
	Sample size	2,459	1,341

Robust standard errors in parentheses. * significant at 5%; ** significant at 1%. The other included variables are ln(months of employment), local unemployment rate, work experience after graduation, age, female, female*children, married, county dummies, a set of dummy variables for the field of study and the first enrollment year. The instrument in the IV models is the mean local unemployment rate during the enrollment.

entry cohorts (1987-1990) and the estimates after ten years are based on two entry cohorts (1987 and 1988).

Control variable estimates (not reported in the tables) are very similar in all model specifications. Results show that in the first year following graduation women have about four percent lower earnings than men and the earnings of men grow faster than women's earnings. Three years later men earn roughly seven percent more than women with same characteristics. The presence of children decreases the earnings of women even more. Marital status does not have a significant effect on earnings. Graduates of medicine, business and engineering have the highest earnings. The difference in earnings between graduates of medicine and humanities is huge: 56-70 percent. The point estimates of the time-to-degree are negative but not always statistically significant. The OLS model including the entire entry cohort predicts that graduates earn 23 percent more than non-graduates eight years from the university entry and 12.5 percent more ten years from the entry. The IV model estimates show that graduates have 43 percent higher earnings than non-graduates eight years after entering university. Ten years after the entry, the point estimate of the graduate

dummy is 0.24, but it is statistically insignificant. Apart from possible wage gains from a completed degree, graduates' higher earnings are explained by the larger number of working hours.

6.3 Robustness

Graduates with extremely long times-to-degree are missing from the used sample because the first enrollment year was constrained to 1987. As an experiment, a sample of individuals who graduated between 1991 and 1996 (with no constraint on the entry year) was constructed from the ES research database and all models were re-estimated using this sample. The whole in-school work experience could not be calculated for this sample so the work experience of the last four study years was used as the measure of in-school work experience.[14] Work experience had a higher impact on the employment probability in this sample. In the employment probability model, the OLS point estimate for in-school work experience varied from 0.10 in the first year to 0.06 in the fifth year after graduation. The IV point estimates in the employment probability model varied from 0.12 to 0.08 and were statistically significant for the first two years after graduation. Furthermore, the effect on earnings is slightly higher in OLS models (from 6.5 % to 3.8 %) during the first five years after graduation if the sample of 1991-1996 graduates is used. IV estimates of the earnings equation resemble the previous results and they were not statistically significant. The instrument used in the IV models was the local unemployment rate during the last four years of study.

The models were also estimated without the field dummies. Excluding the field dummies produces much larger returns to work experience. This is expected since the students in the fields with high graduate earnings tend to work more during the studies. To prevent pure discipline effects from driving the results, field dummies should be included and the comparisons should be made within the field.

[14] This is of course highly endogenous because working affects the timing of the graduation and using the last four study years makes the endogeneity problem even worse.

Some other experiments were also performed to check the robustness of the results. The amount of work experience is likely to increase with the duration of enrollment. Therefore, the in-school work experience was redefined as the work experience acquired during the first five years of study. The work experience was also split into two parts (up to three months and 4-12 months per year[15]) to the catch the possible nonlinear effects. Further, the employment and earnings equations were estimated separately for men and women, and for the largest fields of study. Models were also estimated including controls for parents' income and education to capture the differences in attitudes towards working and studying and the possible financial support from the parents. However, none of these experiments did significantly change the results from the previous specifications.

7. Conclusion

Working during the university studies is an investment in job skills that might generate higher earnings or employment after graduation. On the other hand, working during the studies may also interfere with academic achievement and lead to longer times-to-degree. The essential question is whether the gains from employment are larger than the distortion effect working has on the achievement in university. This study examines the effect of in-school work on employment and earnings after graduation. OLS estimates show that work experience during the enrollment is associated with higher employment probability and higher annual earnings after graduation. However, the amount of work experience one achieves during the studies is not exogenous and adding controls for individual background might not solve the problem of the endogenously chosen amount of in-school work. Instrumental variable technique can be used to correct for the endogeneity bias. Using the local unemployment rate during the studies as an instrument and comparing graduates with equal times-to-degree, the study finds that working yields considerable increase in earnings one year after graduation, and the effect is positive and decreasing but statistically insig-

[15] Even though it is not possible to distinguish work during the school year and work during the holidays, more than three work months per year should indicate that student has also worked during the school year.

nificant in the later years. However, it is likely that working delays graduation. If working is allowed to affect the time-to-degree, the effect of work experience on earnings is much lower and statistically insignificant for all years in the IV models. There are no significant effects on the employment probability when instrumental variable technique is used. Results are similar if the models are estimated for the entire entry cohort rather than just graduates. Graduates' earnings are considerably higher than earnings of dropouts.

The Ministry of Education in Finland is planning to restrict the maximum length of enrollment to the theoretical length of the program plus two years. Thus, in most cases the maximum length of enrollment would be seven years. This restriction could increase students' incentives to study more intensively and decrease the student employment, which could have a negative effect on the graduates' earnings in the short term. However, the losses in earnings should be weighted against the returns to shorter times-to-degree.

References

Angrist, J. D. and A. B. Krueger (2001): Instrumental variables and the search for identification: from supply and demand to natural experiments. *Journal of Economic Perspectives 15, 69-85.*

Becker, G. S. (1962): Investment in human capital: A theoretical analysis. *The Journal of Political Economy 70, 9-49.*

Ben-Porath, Y. (1967): The production of human capital and the life cycle of earnings. *The Journal of Political Economy 75, 352-365.*

Ehrenberg, R. G. and D. R. Sherman (1987): Employment while in college, academic achievement, and postcollege outcomes: A summary of results. *The Journal of Human Resources 22, 1-23.*

Euro Student (2000): Social and economic conditions of student life in Europe 2000. Synopsis and national profiles for Austria, Belgium (Flemish county), Belgium (Wallonia-Brussels Community), Finland, France, Ireland, Italy and The Netherlands. HIHS Hochschul-Informations-System, Hannover 2002, Germany. The study is available from http:\\www.his.de/Eurostudent/download/eurostudent2000.pdf

Finnie, R. and M. Frenette (2003): Earnings differences by major field of study: evidence from three cohorts of recent Canadian graduates. *Economics of Education Review 22, 179-192.*

Green, W. H. (2000): Econometric analysis. 4th edition. Prentice-Hall Inc. New Jersey.

Hakola, T. (2002): Economic incentives and labour market transitions of the aged Finnish workforce. *VATT-Research reports 89.* Government Institute for Economic Research. Helsinki.

Hausman, J. (2001): Mismeasured variables in econometric analysis: problems from the right and problems from the left. *Journal of Economic Perspectives 15, 57-67.*

Hood, A. B., A. Craig, and B. Ferguson (1992): The impact of athletics, part-time employment, and other academic activities on academic achievement. *Journal of College Student Development 33, 447-453.*

Hotz, V. J., L. Xu, M. Tienda, and A. Ahituv (2002): Are there returns to the wages of young men from working while in school? *The Review of Economics and Statistics 84, 221-236.*

Häkkinen, I. and R. Uusitalo (2003): The effect of a student aid reform on graduation. A duration analysis. *Working paper 2003:8, Department of Economics, Uppsala University.*

Hämäläinen, U. (2003): Ylikoulutusta korkeakoulutettujen työmarkkinoilla? *Research report 87.* Labour Institute for Economic Research, Helsinki.

Härkönen, H. (2001): Opiskelijan rahapussilla. Selvitys Helsingin yliopiston opiskelijoiden toimeentulosta ja asumisesta keväällä 2001. Helsingin yliopiston ylioppilaskunta. Helsinki.

Lempinen, P. and A. Tiilikainen (2001): Opiskelijatutkimus 2000. *Student Research Foundation Otus 21/2001.* (National survey of Euro Student 2000. The whole report is available from http:\\www.his.de/Eurostudent/download/eurostudent2000.pdf)

Light, A. (2001): In-school work experience and the returns to schooling. *Journal of Labor Economics 19, 65-93.*

Mincer, J. (1974): Schooling, experience, and earnings. Columbia University Press for National Bureau of Economic Research, New York.

Paul, H. (1982): The impact of outside employment on student achievement in macroeconomic principles. *Journal of Economic Education 13, 51-56.*

Ruhm, C. J. (1997): Is high school employment consumption or investment? *Journal of Labor Economics 15, 735-776.*

Rumberger, R. W. and S. L. Thomas (1993): The economic returns to college major, quality and performance: a multilevel analysis of recent graduates. *Economics of Education Review 12, 1-19.*

Stinebricker, R. and T. R. Stinebricker (2003): Working during school and academic performance. *Journal of Labor Economics 21, 473-491.*

Appendix

Table A1. Descriptive statistics of the data set.

	Graduation year		1 year after graduation		2 years after graduation		3 years after graduation	
	N	Mean	N	Mean	N	Mean	N	Mean
Age	3,745	27.02	2,984	27.94	2,299	28.83	1,614	29.19
Female	3,745	0.56	2,984	0.57	2,299	0.56	1,614	0.56
Female*Children	3,745	0.09	2,984	0.13	2,299	0.16	1,614	0.21
Children	3,745	0.15	2,984	0.21	2,299	0.29	1,614	0.37
Married	3,745	0.30	2,984	0.38	2,299	0.46	1,614	0.54
Months in employment	3,745	6.10	2,984	7.69	2,299	8.02	1,614	8.12
Annual earnings (Euro)	3,745	12,124	2,984	19,208	2,299	21,321	1,614	22,883
Local unemployment rate	3,745	17.24	2,984	16.89	2,299	16.44	1,614	16.01
Time-to-degree	3,745	5.90	2,984	5.75	2,299	5.57	1,614	5.33
Local unemployment rate during studies	3,745	13.33	2,984	12.25	2,299	11.04	1,614	9.53
Years of work while enrolled	3,745	1.88	2,984	1.84	2,299	1.80	1,614	1.75
Work experience after graduation (years)	3,745	0.50	2,984	1.13	2,299	1.75	1,614	2.37
Employed	3,745	0.52	2,984	0.65	2,299	0.66	1,614	0.67
Graduation year 1990	3,745	0.002	2,984	0.003	2,299	0.003	1,614	0.005
Graduation year 1991	3,745	0.016	2,984	0.020	2,299	0.027	1,614	0.038
Graduation year 1992	3,745	0.047	2,984	0.059	2,299	0.076	1,614	0.108
Graduation year 1993	3,745	0.095	2,984	0.118	2,299	0.154	1,614	0.217
Graduation year 1994	3,745	0.123	2,984	0.154	2,299	0.201	1,614	0.286
Graduation year 1995	3,745	0.151	2,984	0.189	2,299	0.245	1,614	0.346
Graduation year 1996	3,745	0.182	2,984	0.228	2,299	0.294		
Graduation year 1997	3,745	0.183	2,984	0.229				
Graduation year 1998	3,745	0.201	2,984					
Arts	3,745	0.02	2,984	0.02	2,299	0.02	1,614	0.02
Humanities and Theology	3,745	0.13	2,984	0.13	2,299	0.12	1,614	0.10
Education and psychology	3,745	0.17	2,984	0.17	2,299	0.20	1,614	0.21
Social sciences	3,745	0.09	2,984	0.09	2,299	0.09	1,614	0.09
Other healthcare	3,745	0.03	2,984	0.03	2,299	0.03	1,614	0.03
Law	3,745	0.04	2,984	0.04	2,299	0.04	1,614	0.05
Business	3,745	0.13	2,984	0.14	2,299	0.14	1,614	0.15
Natural sciences	3,745	0.12	2,984	0.12	2,299	0.11	1,614	0.11
Agriculture and forestry	3,745	0.03	2,984	0.03	2,299	0.02	1,614	0.02
Engineering	3,745	0.18	2,984	0.17	2,299	0.17	1,614	0.16
Medicine	3,745	0.06	2,984	0.06	2,299	0.06	1,614	0.06

Table A2. First-stage estimates of earnings equations one year after graduation.

Dependent variable: Years of work while enrolled	(1)	(2)	(3)	(4)
Employment and earnings are measured one year after graduation	Including time-to-degree		Not including time-to-degree	
	Employment	Earnings	Employment	Earnings
Local unemployment rate during studies	-0.066	-0.053	-0.146	-0.138
	(0.010)**	(0.012)**	(0.009)**	(0.011)**
Local unemployment rate	-0.019	-0.022	-0.001	-0.001
	(0.006)**	(0.009)*	(0.006)	(0.009)
Time-to-degree	0.299	0.330	-	-
	(0.026)**	(0.031)**		
Ln months of employment	-	0.727	-	0.631
		(0.155)**		(0.157)**
Graduation month	-0.030	-0.026	-0.017	-0.014
	(0.007)**	(0.009)**	(0.007)*	(0.009)
Age	0.077	0.106	0.081	0.112
	(0.009)**	(0.010)**	(0.010)**	(0.012)**
Female	0.047	0.042	0.039	0.047
	(0.055)	(0.068)	(0.056)	(0.069)
Female*children	-0.418	-0.364	-0.427	-0.417
	(0.124)**	(0.178)*	(0.127)**	(0.185)*
Children	0.188	0.185	0.233	0.234
	(0.104)	(0.131)	(0.107)*	(0.136)
Married	0.121	0.128	0.085	0.094
	(0.054)*	(0.069)	(0.056)	(0.071)
Engineering	0.352	0.109	0.259	0.042
	(0.090)**	(0.124)	(0.092)**	(0.127)
Arts	0.998	1.246	0.728	0.956
	(0.251)**	(0.289)**	(0.259)**	(0.318)**
Education and psychology	0.232	0.289	0.062	0.200
	(0.093)*	(0.156)	(0.092)	(0.158)
Social sciences	0.378	0.161	0.299	0.072
	(0.107)**	(0.145)	(0.108)**	(0.147)
Other healthcare	0.327	0.008	0.153	-0.172
	(0.131)*	(0.166)	(0.131)	(0.166)
Law	0.409	0.222	0.254	0.064
	(0.156)**	(0.179)	(0.152)	(0.176)
Business	0.365	0.220	0.141	0.005
	(0.100)**	(0.136)	(0.098)	(0.135)
Natural sciences	0.147	0.078	0.100	0.038
	(0.095)	(0.137)	(0.096)	(0.139)
Agriculture and forestry	0.306	0.192	0.114	0.024
	(0.171)	(0.216)	(0.172)	(0.222)
Medicine	-0.432	-0.761	-0.448	-0.792
	(0.110)**	(0.142)**	(0.112)**	(0.142)**

Table continues on the next page

Table continues from the previous page

	(1)	(2)	(3)	(4)
Graduate year 91	0.747	0.797	0.979	0.935
	(0.335)*	(0.373)*	(0.375)**	(0.484)
Graduate year 92	0.786	0.756	1.262	1.183
	(0.335)*	(0.374)*	(0.372)**	(0.483)*
Graduate year 93	0.853	0.928	1.641	1.752
	(0.333)*	(0.371)*	(0.368)**	(0.477)**
Graduate year 94	0.963	0.821	2.098	1.991
	(0.339)**	(0.374)*	(0.367)**	(0.476)**
Graduate year 95	0.954	0.815	2.411	2.331
	(0.348)**	(0.385)*	(0.370)**	(0.479)**
Graduate year 96	1.048	0.849	2.809	2.684
	(0.358)**	(0.398)*	(0.374)**	(0.486)**
Graduate year 97	1.154	0.820	3.153	2.932
	(0.369)**	(0.414)*	(0.380)**	(0.492)**
Constant	-1.961	-4.388	-1.076	-3.208
	(0.433)**	(0.629)**	(0.477)*	(0.707)**
Observations	2,984	1,937	2,984	1,937
R-squared	0.24	0.27	0.20	0.23
Summary statistic from the first stage estimation:				
Partial R-squared of excluded instruments	0.0139	0.0096	0.0999	0.0920
Test of excluded instruments	41.75	18.55	328.23	193.57
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Robust standard errors in parentheses. * significant at 5%; ** significant at 1%

Economic Studies

1987:1 Haraldson, Marty: To Care and To Cure. A linear programming approach to national health planning in developing countries. 98 pp.

1989:1 Chryssanthou, Nikos: The Portfolio Demand for the ECU: A Transaction Cost Approach. 42 pp.

1989:2 Hansson, Bengt: Construction of Swedish Capital Stocks, 1963-87: An Application of the Hulten-Wykoff Studies. 37 pp.

1989:3 Choe, Byung-Tae: Some Notes on Utility Functions Demand and Aggregation. 39 pp.

1989:4 Skedinger, Per: Studies of Wage and Employment Determination in the Swedish Wood Industry. 89 pp.

1990:1 Gustafson, Claes-Håkan: Inventory Investment in Manufacturing Firms. Theory and Evidence. 98 pp.

1990:2 Bantekas, Apostolos: The Demand for Male and Female Workers in Swedish Manufacturing. 56 pp.

1991:1 Lundholm, Michael: Compulsory Social Insurance. A Critical Review. 109 pp.

1992:1 Sundberg, Gun: The Demand for Health and Medical Care in Sweden. 58 pp.

1992:2 Gustavsson, Thomas: No Arbitrage Pricing and the Term Structure of Interest Rates. 47 pp.

1992:3 Elvander, Nils: Labour Market Relations in Sweden and Great Britain. A Comparative Study of Local Wage Formation in the Private Sector during the 1980s. 43 pp.

12 Dillén, Mats: Studies in Optimal Taxation, Stabilization, and Imperfect Competition. 1993. 143 pp.

13 Banks, Ferdinand E.: A Modern Introduction to International Money, Banking and Finance. 1993. 303 pp.

14 Mellander, Erik: Measuring Productivity and Inefficiency Without Quantitative Output Data. 1993. 140 pp.

15 Ackum Agell: Susanne: Essays on Work and Pay. 1993. 116 pp.

16 Eriksson, Claes: Essays on Growth and Distribution. 1994. 129 pp.

17 Banks, Ferdinand E.: A Modern Introduction to International Money, Banking and Finance. 2nd version, 1994. 313 pp.

18 Apel, Mikael: Essays on Taxation and Economic Behavior. 1994. 144 pp.

19 Dillén, Hans: Asset Prices in Open Monetary Economies. A Contingent Claims Approach. 1994. 100 pp.

20 Jansson, Per: Essays on Empirical Macroeconomics. 1994. 146 pp.

21 Banks, Ferdinand E.: A Modern Introduction to International Money, Banking, and Finance. 3rd version, 1995. 313 pp.

22 Dufwenberg, Martin: On Rationality and Belief Formation in Games. 1995. 93 pp.

23 Lindén, Johan: Job Search and Wage Bargaining. 1995. 127 pp.

24 Shahnazarian, Hovick: Three Essays on Corporate Taxation. 1996. 112 pp.

25 Svensson, Roger: Foreign Activities of Swedish Multinational Corporations. 1996. 166 pp.

26 Sundberg, Gun: Essays on Health Economics. 1996. 174 pp.

27 Sacklén, Hans: Essays on Empirical Models of Labor Supply. 1996. 168 pp.

28 Fredriksson, Peter: Education, Migration and Active Labor Market Policy. 1997. 106 pp.

29 Ekman, Erik: Household and Corporate Behaviour under Uncertainty. 1997. 160 pp.

30 Stoltz, Bo: Essays on Portfolio Behavior and Asset Pricing. 1997. 122 pp.

31 Dahlberg, Matz: Essays on Estimation Methods and Local Public Economics. 1997. 179 pp.

32 Kolm, Ann-Sofie: Taxation, Wage Formation, Unemployment and Welfare. 1997. 162 pp.

33 Boije, Robert: Capitalisation, Efficiency and the Demand for Local Public Services. 1997. 148 pp.

34 Hort, Katinka: On Price Formation and Quantity Adjustment in Swedish Housing Markets. 1997. 185 pp.

35 Lindström, Thomas: Studies in Empirical Macroeconomics. 1998. 113 pp.

36 Hemström, Maria: Salary Determination in Professional Labour Markets. 1998. 127 pp.

37 Forsling, Gunnar: Utilization of Tax Allowances and Corporate Borrowing. 1998. 96 pp.

38 Nydahl, Stefan: Essays on Stock Prices and Exchange Rates. 1998. 133 pp.

39 Bergström, Pål: Essays on Labour Economics and Econometrics. 1998. 163 pp.

40 Heiborn, Marie: Essays on Demographic Factors and Housing Markets. 1998. 138 pp.

41 Åsberg, Per: Four Essays in Housing Economics. 1998. 166 pp.

42 Hokkanen, Jyry: Interpreting Budget Deficits and Productivity Fluctuations. 1998. 146 pp.

43 Lunander, Anders: Bids and Values. 1999. 127 pp.

44 Eklöf, Matias: Studies in Empirical Microeconomics. 1999. 213 pp.

45 Johansson, Eva: Essays on Local Public Finance and Intergovernmental Grants. 1999. 156 pp.

46 Lundin, Douglas: Studies in Empirical Public Economics. 1999. 97 pp.

47 Hansen, Sten: Essays on Finance, Taxation and Corporate Investment. 1999. 140 pp.

48 Widmalm, Frida: Studies in Growth and Household Allocation. 2000. 100 pp.

49 Arslanogullari, Sebastian: Household Adjustment to Unemployment. 2000. 153 pp.

50 Lindberg, Sara: Studies in Credit Constraints and Economic Behavior. 2000. 135 pp.

51 Nordblom, Katarina: Essays on Fiscal Policy, Growth, and the Importance of Family Altruism. 2000. 105 pp.

52 Andersson, Björn: Growth, Saving, and Demography. 2000. 99 pp.

53 Åslund, Olof: Health, Immigration, and Settlement Policies. 2000. 224 pp.

54 Bali Swain, Ranjula: Demand, Segmentation and Rationing in the Rural Credit Markets of Puri. 2001. 160 pp.

55 Löfqvist, Richard: Tax Avoidance, Dividend Signaling and Shareholder Taxation in an Open Economy. 2001. 145 pp.

56 Vejsiu, Altin: Essays on Labor Market Dynamics. 2001. 209 pp.

57 Zetterström, Erik: Residential Mobility and Tenure Choice in the Swedish Housing Market. 2001. 125 pp.

58 Grahn, Sofia: Topics in Cooperative Game Theory. 2001. 106 pp.

59 Laséen, Stefan: Macroeconomic Fluctuations and Microeconomic Adjustments: Wages, Capital, and Labor Market Policy. 2001. 142 pp.

60 Arnek, Magnus: Empirical Essays on Procurement and Regulation. 2002. 155 pp.

61 Jordahl, Henrik: Essays on Voting Behavior, Labor Market Policy, and Taxtion. 2002. 172 pp.

62 Lindhe, Tobias: Corporate Tax Integration and the Cost of Capital. 2002. 102 pp.

63 Hallberg, Daniel: Essays on Household Behavior and Time-Use. 2002. 170 pp.

64 Larsson, Laura: Evaluating Social Programs: Active Labor Market Policies and Social Insurance. 2002. 126 pp.

65 Bergvall, Anders: Essays on Exchange Rates and Macroeconomic Stability. 2002. 122 pp.

66 Nordström Skans, Oskar: Labour Market Effects of Working Time Reductions and Demographic Changes. 2002. 118 pp.

67 Jansson, Joakim: Empirical Studies in Corporate Finance, Taxation and Investment. 2002. 132 pp.

68 Carlsson, Mikael: Macroeconomic Fluctuations and Firm Dynamics: Technology, Production and Capital Formation. 2002. 149 pp.

69 Eriksson, Stefan: The Persistence of Unemployment: Does Competition between Employed and Unemployed Job Applicants Matter? 2002. 154 pp.

70 Huitfeldt, Henrik: Labour Market Behaviour in a Transition Economy: The Czech Experience. 2003. 110 pp.

71 Johnsson, Richard: Transport Tax Policy Simulations and Satellite Accounting within a CGE Framework. 2003. 84 pp.

72 Öberg, Ann: Essays on Capital Income Taxation in the Corporate and Housing Sectors. 2003. 183 pp.

73 Andersson, Fredrik: Causes and Labor Market Consequences of Producer Heterogeneity. 2003. 197 pp.

74 Engström, Per: Optimal Taxation in Search Equilibrium. 2003. 127 pp.

75 Lundin, Magnus: The Dynamic Behavior of Prices and Investment: Financial Constraints and Customer Markets. 2003. 125 pp.

76 Ekström, Erika: Essays on Inequality and Education. 2003. 166 pp.

77 Barot, Bharat: Empirical Studies in Consumption, House Prices and the Accuracy of European Growth and Inflation Forecasts. 2003. 137 pp.

78 Österholm, Pär: Time Series and Macroeconomics: Studies in Demography and Monetary Policy. 2004. 116 pp.

79 Bruér, Mattias: Empirical Studies in Demography and Macroeconomics. 2004. 113 pp.

80 Gustavsson, Magnus: Empirical Essays on Earnings Inequality. 2004. 154 pp.

81 Toll, Stefan: Studies in Mortgage Pricing and Finance Theory. 2004. 100 pp.

82 Hesselius, Patrik: Sickness Absence and Labour Market Outcomes. 2004. 109 pp.

83 Häkkinen, Iida: Essays on School Resources, Academic Achievement and Student Employment. 2004. 123 pp.