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# **Labour Market Effects of Polytechnic Education Reform: The Finnish Experience**

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**233**

**Labour Market  
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## **Tiivistelmä**

Tutkimuksen tarkoituksena on arvioida ammattikorkeakoulu-uudistuksen vaikutuksia vastavalmistuneitten asemaan työmarkkinoilla. Ammattikorkeakoulu-uudistuksen asteittainen toteuttaminen tarjoaa erinomaiset mahdollisuudet uudistuksen arviointiin. Tutkimuksessa verrataan ammattikorkeakoulututkinnon suorittaneitten työllisyyttä ja tulotuloa samoista oppilaitoksista ennen uudistusta valmistuneitten työllisyyteen ja tulotuloon. Tutkimus perustuu suureen yksilötason aineistoon, johon on eri rekistereitä yhdistelemällä koottu tietoja 50 prosentista 1990-luvulla eri oppilaitoksista valmistuneista. Selvästi suurin vaikutus amk-uudistuksella oli kaupan ja hallinnon alalla, missä koulutuksen pituus ja rakennekin muuttui merkittävimällä tavalla. Tradenomien työllisyystilanne on oleellisesti parempi kuin samoista kouluista aiemmin valmistuneitten merkonomien. Myös vuosituloilla mitattuna tradenomien työmarkkina-asema on selvästi merkonomeja parempi.

## **Abstract**

This paper evaluates the labour market effects of the introduction of the polytechnic education system in Finland. The reform transformed former vocational colleges gradually into polytechnics. Since the timing of the reform differed across schools, we can control for macroeconomic changes by comparing the performance of the polytechnic graduates to the performance of vocational college graduates who graduated at the same time, and to control for both time and the school fixed effects at the same time. We discover that both employment levels and earnings of post-reform graduates are significantly higher when compared to pre-reform graduates from the same schools. The effects of the polytechnic reform differ between the three largest fields. In the field of business and administration the effects from the reform have been overwhelmingly positive. This is in accordance with the fact that the polytechnic reform extended the length of education mostly in this field.

*JEL Classification:* I21; I23

*Keywords:* educational economics; human capital; salary wage differentials

## 1. Introduction

This paper evaluates the labour market effects of the introduction of the polytechnic education system in Finland that took place in the 1990s. The reform transformed former vocational colleges gradually into polytechnics. Polytechnics constitute a new non-university sector in Finnish higher education and they were established side-by-side with the existing universities. In this paper, we compare polytechnic graduates' employment levels and annual earnings to those who have obtained vocational college degrees from the same schools earlier. Since the timing of the reform differed across schools, we can control for both the school and the year fixed effects. The polytechnic reform that took place during the years 1991-1998 was the largest single education reform in Finland since the reform of the comprehensive school system in the early 1970s.

Skill needs are changing fast across the industrialized countries owing to technological change and globalization. The demand for highly skilled workers has increased across the board (e.g. Green, 2006). Accordingly, polytechnic degrees were introduced in Finland during the early 1990s to meet the new demands of employers for higher vocational skills. By international comparison, the standard of education in Finland is currently at the general European level (OECD, 2003). The education level of Finns has improved rapidly and the gap in the education level between the youngest and oldest generations in Finland is among the highest within the OECD countries (OECD, 2004). Polytechnic graduates have contributed to this dramatic change in the labour market. The very first students from the newly established polytechnics graduated in the year 1994. The system expanded rapidly during the late 1990s. By 2000 the number of new polytechnic graduates already exceeded the number of new university graduates.

Despite the apparent importance of the reform, the empirical evidence about the labour market effects of this reform is sparse. The reform aimed to improve the vocational skills of graduates. Accordingly, the overall success of the polytechnic education reform should be evaluated primarily by assessing its effects on the labour market outcomes. Earlier evidence about the reform is mostly based on surveys conducted among graduates from polytechnics that reflect the graduates' own subjective views about the

content of their jobs and overall placement in the labour market.<sup>1</sup> Those studies have usually focused on job quality of recently graduated.

Moreover, an extensive assessment about the overall success of the reform by OECD (2003) that takes advantage of register-based data sources to examine the labour market status of polytechnic graduates after graduation does not take into account the structure of the reform to control for the differences between schools nor the macroeconomic effects during the reform. As argued in detail later, it is important to incorporate these effects when providing estimates about the labour market effects of the reform. For example, OECD (2003, p. 88) reports that 3.7% of all polytechnic graduates were unemployed one year after graduation in the year 1998. This number can be considered to be either ‘low’ or ‘high’ depending on the yardstick that is used in the comparison. Because former vocational colleges were gradually transformed into polytechnics during the reform, we argue that it is most natural to compare polytechnic graduates’ labour market outcomes to those who have obtained vocational college degrees from the same schools earlier. The purpose of this paper is to perform that comparison by using matched data that is gathered from several registers maintained by Statistics Finland. The primary source of data is the Register of Completed Education and Degrees.

Our paper is most closely related to the literature that has taken advantage of the changes in educational system to examine the causal effects of education on different labour market outcomes. For example, Harmon and Walker (1995) have utilised the change in the minimum school-leaving age as a source of exogenous variation in educational attainment to estimate the economic return to education in the UK. Furthermore, Meghir and Palme (1999) have taken advantage of the gradual implementation of the nine-year comprehensive school system in Sweden in the 1950s, and Ekström (2003) has evaluated the 1991-reform in which a third year was added to Swedish upper secondary vocational education. Recently, Pekkarinen et al. (2006) have utilised the Finnish comprehensive school reform to examine the changes in intergenerational income mobility.

The most important finding of this paper is that both employment levels and annual earnings of post-reform graduates are significantly higher when compared to pre-reform

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<sup>1</sup> Stenström (2006) documents the results of a recent postal survey. The survey covers the study fields of business and administration, technology and transport, and health and social care. Stenström’s (2006) main finding is that polytechnic graduates have been successful in making their entry to the labour market.

graduates from the same schools. Furthermore, the effects of polytechnic reform differ greatly between the three largest fields. The reform had no substantial effect in either technology and transport or social and health care fields. In contrast, in the field of business and administration the effects from the reform are overwhelmingly positive on graduates' earnings and employment levels.

The paper proceeds as follows. Section 2 provides a description of the Finnish education system and the polytechnic education reform. Section 3 explains our empirical approach. Section 4 introduces the matched data that is used to address the issues at hand. Section 5 reports our results and the last section concludes.

## **2. The Finnish education system and the polytechnic reform**

### *2.1. The Finnish education system*

Students begin school at the age of seven. Compulsory comprehensive school lasts for nine years.<sup>2</sup> After comprehensive school about 55 per cent of the students continue in the upper secondary school that lasts for three years and ends with a matriculation examination. The other 45 per cent enter into various vocational schools and vocational colleges that last for two to three years.

Vocational schools and colleges were a diverse group of schools in the beginning of 1990s. The length of education and entry requirements varied between schools. Some took most students directly from comprehensive schools and provided them with two or three years of vocational education. In some vocational colleges most students had completed upper secondary school before entering vocational college. For example, a business degree from a vocational college typically required three years of schooling after comprehensive school or two years of schooling after upper secondary school. Engineering degree from a technical college required that the students had either vocational school or upper secondary school degree before entering. Education at technical college typically took four years to complete. In nursing school most students had completed upper secondary school before entering, and vocational college lasted for around three years.

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<sup>2</sup> An up-to-date English language overview of the Finnish education system can be found from the country background report for the OECD thematic review of tertiary education in Finland (Ministry of Education, 2005).

Highest education in Finland has traditionally been provided by state universities. The students are accepted directly to a Master's program that takes, on average, five to six years to complete. Vast majority of students enter university after completing upper secondary school, but it is also possible to apply with a vocational college degree. As a consequence of the polytechnic education reform, the higher education system nowadays comprises of two parallel sectors, which are state universities and vocationally oriented polytechnics. Accordingly, Finland transformed itself from a unitary to a binary system of higher education during the 1990s. A major difference is that polytechnic schools are not engaged in academic research like state universities.

Education is free at all levels. State financed student aid and subsidized loans make possible to pursue education irrespective of financial circumstances of the family. Good employment prospects for graduates and reasonably high monetary returns to education have kept the demand for education high.<sup>3</sup> Supply of education is controlled by the Ministry of Education through its decisions on the number of study places at universities and through its funding decisions to other schools. The number of applications to universities and to most popular vocational colleges exceed the number of available places by a factor of four. Entrance exams and/or previous grades are used to select students to most schools at all levels.

## *2.2. The polytechnic reform*

The most important aim of the introduction of the polytechnic education system in Finland was to respond to new demands of vocational skills that were seen to arise in the labour market.<sup>4</sup> The creation of the polytechnic system meant a rapid expansion in the provision of higher education. Furthermore, the purpose of the reform was to raise the general educational standard and training of Finns and to diversify higher education. Other objectives of the reform included pooling resources in vocational schooling to larger units and making Finnish education system more comparable to educational systems in other European countries. One background factor for the introduction of polytechnic education was the large number of matriculated students who did not have a student place in higher education. This was caused by the rapid increase of matriculated students from upper secondary schools.

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<sup>3</sup> Card (1999) presents a survey of the literature on the return on education. Uusitalo (1999) provides estimates for Finland.

<sup>4</sup> The Ministry of Education (1990), among others, has stated these objectives.



The first 22 polytechnics were established under a temporary license in 1991 (e.g. Lampinen, 2004). These polytechnics were created by joining several vocational colleges and vocational schools, often operating at several locations. Polytechnics were altogether formed from some 215 individual institutes (OECD, 2003). Seven new temporary licenses were granted over the 1990s so that currently there are 29 polytechnics. The experimental phase was judged to be successful and starting in 1996 the temporary polytechnics have gradually become permanent. Since August 2000 all polytechnics have been permanent. The polytechnics have between 600 and 6500 students (OECD, 2003). Most of polytechnics are multidisciplinary and the network of polytechnics covers the whole country. One of the many goals of the polytechnic reform was to promote regional development and meet regional needs for higher education (OECD, 2003). Polytechnic degrees are Bachelor-level higher education degrees with a vocational emphasis.<sup>5</sup> These degrees take around 3.5 to 4 years to complete.<sup>6</sup>

The first graduates from the new polytechnics entered the labour market in 1994. The number of graduates grew rapidly and by 2000 the number of new polytechnics graduates exceeded the number of new university graduates. The three largest fields were business and administration, social and health care (typically nursing), and technology and transport (typically engineers) (Figure 1). Each year, between eighty and ninety per cent of all polytechnics degrees were granted from these three fields.

Figure 1 around here

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<sup>5</sup> These degrees are equivalent to the Bachelor of Arts (Hons) or Bachelor of Science (Hons) Degrees in the UK, the French Licence, the German Diplom Fachhochschule and the Dutch HBO Diploma.

<sup>6</sup> The average actual completion time was, for example, 3.9 years in 2004, according to the so-called AMKOTA database maintained by the Ministry of Education to document the performance of polytechnic schools.

The reform changed the curriculum to different extent in different fields. Our impression based on extensive discussions with the school administrators and officials from the Ministry of Education is that the changes in the engineering and nursing education were relatively minor. Also the average length of studies in these fields was unchanged. In contrast, there were substantial changes in the business education. The average length of the studies increased from two years to three and a half years. Furthermore, the graduates received new degree titles (Bachelors of Business Administration, *tradenomi* in Finnish) that distinguished them from the earlier graduates from these schools (Diplomas in business and administration (vocational college), *merkonomi* in Finnish). Consequently, it is reasonable to expect that polytechnic graduates at least in the field of business and administration have been able to obtain some amount of positive “value-added” from their degrees, because the polytechnic degrees take more time to complete than the earlier vocational college degrees.

The polytechnics were created by gradually upgrading vocational colleges into polytechnics. Figure 2 reports the number of degrees by the level of education over the period 1990-2000. Looking across all fields, the number of graduates from secondary-level vocational education remained rather stable and the number of university degrees have increased over time. Universities continued their operation during the reform period without any major changes. The main change in the distribution of the degrees is the gradual decrease in the number of vocational college degrees and the corresponding increase in the polytechnic degrees.

Figure 2 around here

### **3. Empirical approach**

Our strategy derives from the fact that a direct comparison of employment levels and earnings for polytechnic graduates and vocational college graduates is clearly not appropriate for at least two reasons. First, a direct comparison of the outcomes in any given year is problematic, because there are substantial differences between schools and especially because the first polytechnics were created from the vocational colleges whose graduates had relatively good labour market opportunities even before the polytechnic education reform. Accordingly, the effects that stem from the polytechnic reform would be mixed with the differences between schools.

Second, a direct comparison of polytechnic graduates and vocational college graduates within the schools over time is problematic, because the overall labour market situation of all graduates has improved rapidly during the late 1990s. Finland experienced its largest peacetime depression in the beginning of 1990s. The unemployment rate increased from 3.3 per cent in 1991 to 16.6 per cent in 1994 (e.g. Koskela & Uusitalo, 2006). Recovery from the economic crisis of the early 1990s took place in the period from 1994 to 2002 when the average GDP growth rate was close to four per cent. The vast majority of the polytechnic graduates entered the labour market under much better overall demand conditions than those who had graduated from the same schools with vocational college degrees in the early 1990s. It is clear that a direct comparison of employment levels and earnings would then give a very large positive effect for the polytechnic reform even when it did not have any real effect on earnings or labour market status of recently graduated.

To overcome the above-mentioned problems in the identification of the labour market effects of the reform, we have assembled matched data from several different registers maintained by Statistics Finland. In particular, we compare in this paper the students who have graduated from the vocational colleges before and after the polytechnic reform. Since the timing of the reform differed across schools, we can also control for other macroeconomic changes and the general changes in the return to education by comparing the performance of the polytechnic graduates to the performance of vocational college graduates who graduated at the same time, and to control for both time and school fixed effects at the same time.

Accordingly, we estimate regression models for annual earnings and labour market status where we in addition to having a polytechnic degree control for the school fixed effects and the graduation year fixed effects. The OLS models are formulated as follows:

$$Y_{ijt} = \mathbf{b}_{i1} \text{POLYTECHNIC}_{ijt} + \mathbf{b}_{i2} \text{SCHOOL}_{ij} + \mathbf{b}_{i3} \text{YEAR}_{it} + \mathbf{b}_{i4} \text{CONTROLS}_{ijt} \quad (1)$$

where our variable of interest,  $\text{POLYTECHNIC}_{ijt}$  is an indicator that a person  $i$  has taken a polytechnic degree from a school  $j$  in the year  $t$ ,  $\text{SCHOOL}_{ij}$  presents the school fixed effects,  $\text{YEAR}_{it}$  stands for the graduation year fixed effects and  $\text{CONTROLS}_{ijt}$  contains

some additional background characteristics for individuals such as age and mother tongue. The motivation for this specification is that with an inclusion of a full set of indicators for schools, we are able to control for the permanent differences between schools. In particular, indicators assigned for schools take into account the gradual transformation of vocational colleges into polytechnics during the reform. Hence, vocational colleges obtain the same values for school indicators before and after their transformation into polytechnics. Furthermore, by adding the year effects to the model, we are able to control for business cycle effects that have similar effects for all recently graduated.

#### **4. Data**

Our data is based on a 50% random sample of all individuals who have received a degree from any post-compulsory schooling in Finland over the period 1990-2000. The primary source of data is the Register of Completed Education and Degrees maintained by Statistics Finland. Schools report all degrees granted directly to Statistics Finland and the register has universal coverage of all degrees from all schools in Finland. Information in the register is stored at the student level and include unique personal identifier, school code, type of school and program, degree title and year granted. In addition, the register includes a history file that allows tracking schools when several schools have been merged into one. This allows creating a link that enables the identification of the vocational colleges that formed each polytechnic. In particular, the link makes it possible to compare polytechnic graduates to those who have graduated from the very same schools earlier and to assign the school fixed effects to our regression models. For confidentiality reasons the school id's were re-coded so that the individual schools can no longer be identified, but the link between the pre-reform and the post-reform school codes was kept in data.

We have merged, by using personal identification codes, our sample of individuals from the Register of Completed Education and Degrees to Employment Statistics (ES) that is essentially an annual population census. ES contain information of all employment and unemployment spells from pension insurance funds and unemployment registers, as well as, annual earnings obtained from the Finnish tax authorities. Labour market status of individuals is recorded in ES during the last week of each year. Annual earnings are calculated by adding up earned income and entrepreneurial income, and they are deflated to the year 2002. ES that is maintained by Statistics Finland is particularly

useful for our purposes, because it covers all sectors. This is important, because the estimates of the labour market effects for particular sectors could be subject to severe selection bias, if the unobserved factors that determine whether polytechnic graduates choose to work in a particular sector also influence their earnings and other labour market outcomes. By using ES the individuals can be followed over time. Time series data on individuals allows calculating various employment history measures at the individual level. We use this information to calculate work experience for each person at the time of graduation. In this paper, work experience is calculated by adding up work months five years before a person graduates. Furthermore, from ES we obtain other useful background characteristics for individuals such as gender, age and mother tongue that can be used as additional control variables to account for the possible changes in student composition. Our observation period includes the years from 1987 to 2002.

Moreover, we have obtained data on the matriculation examination results for the persons who have graduated from upper secondary school between 1988 and 1997. The matriculation examination is a national compulsory final exam taken by all students who graduate from upper secondary school. The exam takes place simultaneously in all schools. The answers in each test are first graded by teachers on the scale from 1 to 6 and then reviewed by the associate members of the Matriculation Examination Board outside the schools. The exam scores are standardized so that their distribution is the same every year. In early 1990s, the exam included four compulsory and two optional tests. In the data that is provided by the Matriculation Examination Board all grades in all tests are reported. In this study, we use the sum of four best exam scores to approximate student's ability. It is used to account for the possible changes in student composition during the reform. Because in Finland it is common to obtain several degrees one after another, we have also added person's earlier degrees from the Register of Completed Education and Degrees to our matched data. Earlier degrees that were added to the data include matriculation examination, secondary-level vocational education, vocational college education and university degree.

## 5. Results

We examine the effects of the polytechnic reform on the labour market outcomes in the years following the graduation year, so that we avoid the need to adjust for the different graduation dates, but still observe the students as soon as possible after graduation. As outcome measures, we use both annual earnings in year  $t+1$  and  $t+2$ , and employment and unemployment at the end of the year  $t+1$  and  $t+2$ . As an additional outcome variable, we use the probability of still being a student after graduation, because one of the several aims of the polytechnic education reform was to decrease the continuation of studies after graduation.

Our first set of estimates for the effects of the polytechnic reform on annual earnings, employment, unemployment and the probability of continuation of studies after graduation are documented in Table 1. The upper panel of the table shows the results for all polytechnic degrees. The following panels show our separate estimates for the three largest fields that are technology and transport, social and health care, and business and administration. We include in the regression models all degrees from the vocational colleges that have in some point of time transformed themselves into polytechnics over the period 1994-2000. The reason for the beginning of our observation period is that the first students from the newly established polytechnics graduated in 1994. The latest information available on the labour market outcomes for graduates in ES is available for the year 2002. Hence, persons who have graduated in 2000 constitute the last cohort for which we are able to follow their labour market situation two years after graduation. In the following tables, we report only the effects for obtaining a polytechnic degree, not the results for the control variables included.

Table 1 around here

Our baseline specifications show that annual earnings and employment levels of post-reform graduates are significantly higher when compared to pre-reform graduates from the same schools. The results in upper panel of Table 1 that include all fields show that obtaining a polytechnic degree increases annual earnings around €5000 one year after graduation and almost €400 two years after graduation. Annual earnings are partly increased owing to improvement in employment. Employment for polytechnic graduates is 11.6 percentage points higher than for vocational college graduates from

the same schools one year after graduation and 9.9 percentage points higher two years after graduation. Furthermore, the results reveal that the improvement in employment for polytechnic graduates is partly driven by the decrease in the probability of being unemployed and the reduction in the probability of continuation of studies after graduation. Both of these effects are around 4-5 percentage points, based on our evidence.

The overall estimates for all fields conceal the fact that the effects of the polytechnic reform differ greatly between the three largest fields (Table 1). The reform had actually no substantial effect on the labour market outcomes in either technology and transport or social and health care. The effect of obtaining a polytechnic degree is positive on employment and negative on unemployment in both of these fields, but the quantitative magnitude of the estimates is small and they are with few exceptions not statistically significant. In contrast, in the field of business and administration the effects of the reform are overwhelmingly positive. Our point estimates show that a polytechnic degree in the field of business and administration increases annual earnings around €8500 one year after graduation and almost €9000 two years after graduation. In addition, employment for polytechnic graduates in the field of business and administration is 22 percentage points higher than for vocational college graduates from the same schools one year after graduation and 19 percentage points higher two years after graduation. As in the case of our overall estimates, an increase in employment among polytechnic graduates comes from the reduction in the probability of being unemployed and the decrease in the probability of continuation of studies after graduation.

In addition to taking into account the school fixed effects and the overall business cycle fluctuations over the period with the graduation year fixed effects, it is important to check the robustness of the basic findings by controlling for the potential changes in student composition. Descriptive evidence points out that there seems to be changes in student composition in the fields of business and administration, and social and health care during the 1990s (Böckerman et al. 2006, p. 26-30). In particular, the share of matriculated students has increased in those fields. In addition, students' ability measured by the sum of four best exam scores in matriculation examination has increased in the field of business and administration during the reform. We have therefore added individual background characteristics (gender, age and its square, work experience, mother tongue and earlier degrees) to our baseline models. Furthermore, in

the baseline specifications the definition for being employed was a rather loose one. It was enough that a person was employed during the last week of the year, based on ES. In fact, for many of the persons that were classified as being employed in the baseline specification, the level of annual earnings was low. For this reason, it makes sense to require a stricter definition for being employed. Hence, we require in the following that those who are accounted as being employed have to have annual earnings of at least €600 euros (€800 per month) in addition to not being a student one year after graduation during the Autumn term.

The results that take into account the potential changes in student composition and include a stricter definition for being employed are reported in Table 2. In contrast to baseline specifications, we explain the logarithm of annual earnings. Accordingly, these estimates can be interpreted as the percentage difference in the outcome variable between the polytechnic and vocational degree graduates. Our basic conclusions about the labour market effects of the reform remain largely the same. In the field of technology and transport, there seems to be some positive effects from obtaining a polytechnic degree on employment and earnings. Surprisingly, in the field of social and health care, there are some negative effects on earnings. However, those particular effects disappear when we focus only on matriculated students and include the sum of four best exam scores in matriculation examination as an additional explanatory variable. Most importantly, in the field of business and administration the positive effects from the reform remain. The positive effects are smaller than in the baseline specifications, but still substantial even when we focus only on matriculated students and incorporate the sum of four best exam scores in matriculation examination to approximate student's ability.

Table 2 around here

In all earlier models (Tables 1-2), we controlled for the permanent differences between schools with fixed effects. However, it is possible that there has been a selection of students within the same schools to different levels of education according to their ability, because most of vocational college schools transformed themselves gradually into polytechnics during the period 1991-1998. If inherently more able students for some reason or other have been selected into studying polytechnic degrees within schools, our estimates in Tables 1-2 for the labour market effects of the polytechnic



education reform can be biased upwards. To account for this potential source of bias, we have aggregated our matched data to the school level. Hence, we examine the average level of annual earnings and the average level of employment among recently graduated at the school level, which is explained by the average share of polytechnic degrees taken in a school along with our basic control variables that are also aggregated to the school level. The results for employment and annual earnings are reported in Table 3. These findings point out that in the field of business and administration there are evidently positive effects for the share of polytechnic degrees taken in a school. However, the positive effects for annual earnings seem to be largely driven by the changes in student composition. Furthermore, the results from the aggregated data confirm that in other fields than business and administration the polytechnic reform had no positive effects.

Table 3 around here

## **6. Conclusions**

This paper evaluates the labour market effects of the introduction of the polytechnic education system in Finland that took place in the 1990s. Former vocational colleges were gradually transformed into polytechnics during the reform. The prior research about the effects of this large-scale reform is sparse even though the introduction of the polytechnic education was the largest single education reform in Finland since the reform of the comprehensive school system in the early 1970s. In this paper, we use matched data that is gathered from several different registers maintained by Statistics Finland. The primary source of data is the Register of Completed Education and Degrees maintained by Statistics Finland. Since the timing of the reform differed across schools, we can control for other macroeconomic changes and the general changes in the return to education by comparing the performance of the polytechnic graduates to the performance of vocational college graduates who graduated at the same time, and to control for both time and school fixed effects at the same time. The approach adopted in the paper allows us to detect the causal effects.

We discover that both employment levels and earnings of post-reform graduates are significantly higher when compared to pre-reform graduates from the same schools. Interestingly, the effects of polytechnic reform differ greatly between the three largest fields. The reform had no substantial effect in either technology and transport or social

and health care fields. In contrast, in the field of business and administration the effects from the reform are overwhelmingly positive on earnings and employment levels. This pattern is in accordance with the fact that the polytechnic reform extended the length of education and changed its content mostly in the field of business and administration. Our paper therefore provides evidence on the positive economic returns to increasing the length of education.

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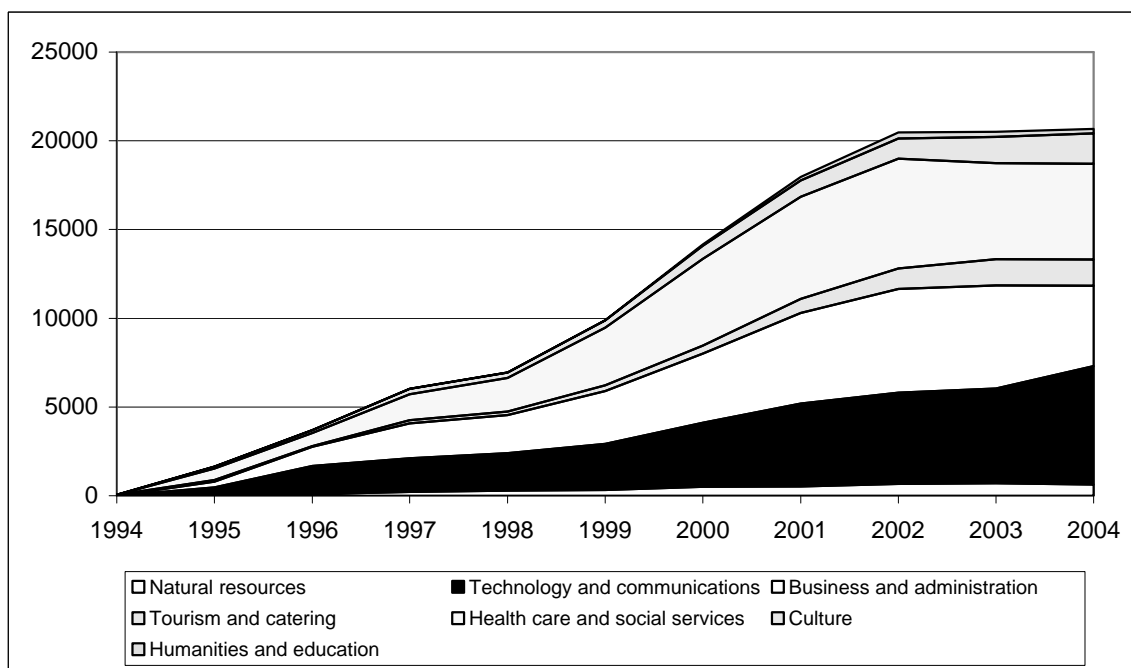
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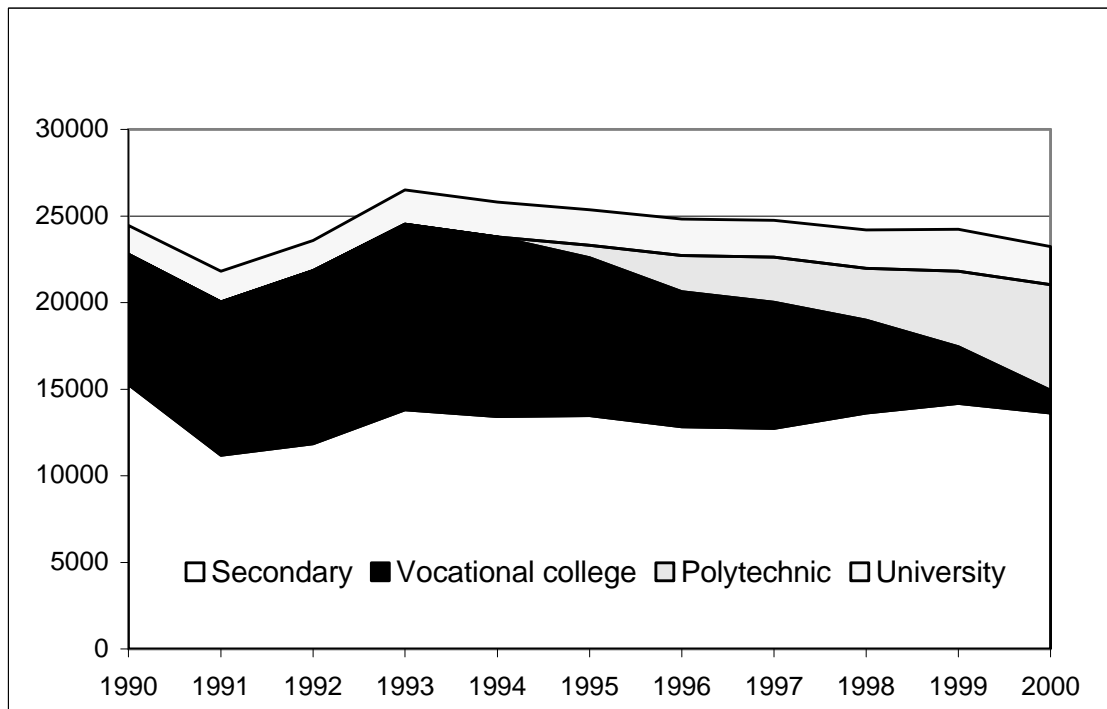
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**Figure 1. Polytechnics degrees by the field 1994–2004.**



Source: AMKOTA database by the Ministry of Education

**Figure 2. Degrees completed by the level of education.**



Source: Own calculation based a 50% random sample from the Register of Completed Education and Degrees

**Table 1. The effect of the polytechnic reform on earnings and labour market status at the individual level.**

<b>All fields</b>								
	(1) Earnings t+1	(2) Earnings t+2	(3) Employed t+1	(4) Employed t+2	(5) Unemployed t+1	(6) Unemployed t+2	(7) Student t+1	(8) Student t+2
POLYTECHNIC	5007 (109)**	5379 (117)**	0.116 (0.005)**	0.099 (0.004)**	-0.053 (0.003)**	-0.041 (0.003)**	-0.048 (0.003)**	-0.052 (0.003)**
N	66359	66359	66406	66406	66406	66406	66406	66406
R <sup>2</sup>	0.09	0.09	0.03	0.02	0.03	0.02	0.01	0.01
<b>Technology and transport</b>								
	Earnings t+1	Earnings t+2	Employed t+1	Employed t+2	Unemployed t+1	Unemployed t+2	Student t+1	Student t+2
POLYTECHNIC	705 (383)	677 (388)	0.016 (0.011)	0.041 (0.010)**	-0.009 (0.008)	-0.015 (0.006)*	-0.005 (0.008)	-0.017 (0.007)*
N	11320	11320	11330	11330	11330	11330	11330	11330
R <sup>2</sup>	0.09	0.11	0.04	0.02	0.02	0.02	0.02	0.01
<b>Social and health care</b>								
	(1) Earnings t+1	(2) Earnings t+2	(3) Employed t+1	(4) Employed t+2	(5) Unemployed t+1	(6) Unemployed t+2	(7) Student t+1	(8) Student t+2
POLYTECHNIC	-147 (185)	-173 (198)	0.024 (0.010)*	0.005 (0.009)	-0.014 (0.007)	-0.009 (0.007)	-0.001 (0.004)	0.000 (0.004)
N	22477	22477	22503	22503	22503	22503	22503	22503
R <sup>2</sup>	0.04	0.03	0.02	0.02	0.02	0.03	0.00	0.00
<b>Business and administration</b>								
	Earnings t+1	Earnings t+2	Employed t+1	Employed t+2	Unemployed t+1	Unemployed t+2	Student t+1	Student t+2
POLYTECHNIC	8486 (175)**	9060 (184)**	0.220 (0.008)**	0.186 (0.008)**	-0.010 (0.006)**	-0.075 (0.005)**	-0.010 (0.006)**	-0.102 (0.006)**
N	24014	24014	24021	24021	24021	24021	24021	24021
R <sup>2</sup>	0.21	0.19	0.07	0.05	0.04	0.03	0.03	0.02

Notes: In columns the results from separate regression models are presented in which each of the explanatory variable (annual earnings, the probability of being employed, the probability of being unemployed and the probability of being student after graduation) is explained with the indicators for schools and graduation years, and our variable of interest (POLYTECHNIC) that identifies a polytechnic degree. The control variables are not reported. Robust standard errors are reported in parentheses and significance is indicated by \*\* (1%), \* (5%).

**Table 2. The effect of the polytechnic reform on labour market status and earnings at the individual level.**

**Technology and transport**

	(1) Employed	(2) Employed	(3) Employed	(4) Earnings	(5) Earnings	(6) Earnings
POLYTECHNIC	0.023 (0.013)	0.032 (0.013)*	0.034 (0.019)	0.016 (0.012)	0.023 (0.011)*	0.019 (0.016)
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	11098	11022	5460	8117	8109	3849
R <sup>2</sup>	0.05	0.15	0.16	0.07	0.30	0.29

**Social and health care**

	(1) Employed	(2) Employed	(3) Employed	(4) Earnings	(5) Earnings	(6) Earnings
POLYTECHNIC	0.010 (0.010)	0.008 (0.010)	0.029 (0.016)	-0.027 (0.008)**	-0.020 (0.007)**	-0.012 (0.011)
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	22503	22294	9826	13574	13567	5406
R <sup>2</sup>	0.03	0.12	0.09	0.04	0.24	0.15

**Business and administration**

	(1) Employed	(2) Employed	(3) Employed	(4) Earnings	(5) Earnings	(6) Earnings
POLYTECHNIC	0.325 (0.009)**	0.220 (0.010)**	0.242 (0.016)**	0.217 (0.008)**	0.144 (0.008)**	0.121 (0.013)**
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	24021	23888	10382	11550	11540	5539
R <sup>2</sup>	0.12	0.23	0.18	0.21	0.42	0.37

Notes: In columns the results from separate regression models are presented in which each of the explanatory variable (the probability of being employed at t+1 and a logarithm of annual earnings at t+1) is explained with the indicators for schools and graduation years, and the variable (POLYTECHNIC) that identifies a polytechnic degree. In addition, in columns 2-3 and 5-6 also other background characteristics (gender, age and its square, work experience, mother tongue and earlier degrees) are controlled for. In columns 3 and 6 only matriculated students are included with the sum of four best exam scores in matriculation examination as an additional explanatory variable. Robust standard errors are reported in parentheses and significance is indicated by \*\* (1%), \* (5%).

**Table 3. The effect of the polytechnic reform on labour market status and earnings at the school level.**

**Technology and transport**

	(1)	(2)	(3)	(4)	(5)	(6)
	Employed	Employed	Employed	Earnings	Earnings	Earnings
POLYTECHNIC	-0.000 (0.023)	-0.003 (0.032)	-0.008 (0.032)	0.012 (0.022)	0.008 (0.017)	-0.000 (0.025)
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	157	157	157	157	157	157
R <sup>2</sup>	0.74	0.63	0.64	0.74	0.82	0.76

**Social and health care**

	(1)	(2)	(3)	(4)	(5)	(6)
	Employed	Employed	Employed	Earnings	Earnings	Earnings
POLYTECHNIC	-0.000 (0.027)	0.007 (0.024)	0.008 (0.028)	-0.042 (0.024)	-0.024 (0.018)	-0.003 (0.022)
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	167	167	165	167	167	164
R <sup>2</sup>	0.77	0.77	0.77	0.60	0.72	0.71

**Business and administration**

	(1)	(2)	(3)	(4)	(5)	(6)
	Employed	Employed	Employed	Earnings	Earnings	Earnings
POLYTECHNIC	0.222 (0.030)**	0.085 (0.026)**	0.153 (0.035)**	0.144 (0.035)**	0.008 (0.027)	0.038 (0.026)
Indicators for schools and graduation years	Yes	Yes	Yes	Yes	Yes	Yes
Other background characteristics	No	Yes	Yes	No	Yes	Yes
Sample	All	All	Matriculated	All	All	Matriculated
N	167	167	166	166	166	160
R <sup>2</sup>	0.91	0.84	0.69	0.87	0.85	0.82

Notes: In columns the results from separate regression models are presented in which each of the explanatory variable (the share of graduates that is employed at t+1 and the average level of graduates' annual earnings at t+1) is explained with the indicators for schools and graduation years, and the variable (POLYTECHNIC) that identifies the share of polytechnic degrees taken in a school. In addition, in columns 2-3 and 5-6 also other background characteristics (gender, age, work experience, mother tongue and earlier degrees) as shares of graduates are controlled for. In columns 3 and 6 only matriculated students are included with the average sum of four best exam scores in matriculation examination as an additional explanatory variable. Robust standard errors are reported in parentheses and significance is indicated by \*\* (1%), \* (5%).