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COLLEGE CHOICE AND SUBSEQUENT EARNINGS. RESULTS USING SWEDISH SIBLING DATA

by

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College choice and subsequent earnings

Results using Swedish sibling data

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ABSTRACT

We use data on 19 000 siblings to investigate whether earnings vary among students who graduated from different colleges in Sweden. We run separate within-family regressions for whole siblings, sisters and brothers. The results show that earnings vary significantly among students who have graduated from different colleges. The cross-sectional estimates are up to twice the within-family estimates, showing that a regression estimator of college effects that does not adjust properly for family characteristics will overestimate the earnings premium of college type as well as the differences in earnings after graduation from different colleges. There is a significant relationship between college type and earnings, even when we control for area of residence after college education. The paper also examines the extent to which differences among colleges, in the proportion of teachers with doctoral degrees, explain the differences in earnings premium. We find that the earnings premium of college type becomes insignificant when adding the proportion of teachers with doctoral degrees to the analysis.

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1. Introduction

For a long time, economics literature on education has focused on quantifying economic return from an additional year of schooling or the wage premium from different levels of education.[1] More recently, researchers started examining the link between school quality and earnings.[2] In comparison, little work has been done to investigate the earnings effects of college quality.

Various reasons explain why college quality may influence earnings, conditional on individual characteristics. Peer effects, curricular design, instructional quality, quality of teachers etc. may facilitate accumulation of human capital at varying rates. For example, the percentage of the teaching staff with doctoral degrees at Swedish colleges varies between 20% and 70% (National Agency for Higher Education, 2001). Another reason is that college type can be positively correlated with individual productivity, and employers use college type as a screening device. Naturally, estimates of the payoff from graduating from a certain college are important to prospective students. Most industrialized countries allocate a limited amount of educational expenditures to different colleges. So knowledge about the effects of college types is also important to policy makers.

This paper investigates the effects of college type on annual earnings, using Swedish data. Sweden ranks among the top-three OECD-countries that spend most on higher education. Further, the past four decades have seen an increase in the accessibility of higher education. In 1950, 16 000 persons were enrolled in higher education; in 1999 the number grew to about 310 000. During the same period, the number of universities and colleges grew from four to 39 (Öckert and Regnér 2000). Other interesting aspects of the Swedish system for higher education are that the government finances the production of education at colleges, completely or partly; university education is free of charge, and all students receive financial support from the government.[3] Admission is

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1. See Angrist & Kreuger (1999) and Card (1999) for discussions of this research. See Björklund (2000) and Arai and Kjellström (1999) for discussions of Swedish evidence.

2 See, for example, the special issue of *Review of Economics and Statistics* November 1996.

3 Students receive study grants as long as their earnings do not exceed a certain amount and as long as they pass exams.

based on formal measures, mainly high school grades and national university aptitude test scores. So compared to universities in the US, for example, a Swedish university cannot choose freely among eligible students, and a student's financial situation probably won't affect the choice of college type. Consequently, Swedish data are less exposed to selection related to colleges' admission decisions and financial aid system than, for example, US data (Dale & Krueger 2002).

Most studies of the effects of college quality use US data to address the question "does the type of college that students attend influence their subsequent earnings?" (Dale & Krueger 2002; Monks 2000; Brewer, Eide & Ehrenberg 1999; Behrman, Rosenzweig & Taubman 1996; Datcher Loury & Garman 1995).[4] A general problem with analyzing this question is that students who attend a more selective college may have higher initial endowments and receive more parental support at home, compared to students who attend other colleges. Failing to adjust for these problems may lead to biased impact estimates of college type.

Past studies use different approaches to adjust for students' non-random selection of colleges. Dale & Krueger (2002) run earnings regressions on students who were accepted and rejected by a comparable set of colleges, controlling for family income. Monks (2000) run wage regressions that include controls for family income and results on the *Armed Forces Qualification Test* (AFQT). Brewer *et al.* (1999) model students' choice of college and add a selection-correction term to the wage equation, which also includes family income and both parent's education. Tuition and financial aid identify the college selection equation. Behrman *et al.* (1996) use data on female twins born in Minnesota to difference out common unobserved family effects. In all, the results show that students who graduated from a more selective college earn significantly more than other students. Adjusting for selection of college students does not affect the estimated effects of college type (Brewer *et al.* 1999), leads to a downward adjustment (Dale & Krueger 1998), and mainly an upward adjustment (Behrman *et al.* 1996).[5]

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[4] Behrman *et al.* (1996) also examine the earnings effects of student enrollment rates, salaries of senior faculty, students per faculty and expenditures per student.

[5] Results in Behrman *et al.* suggest that the estimated earnings effect of private college is adjusted slightly downward, while the estimated effect of doctoral degree-granting institution is adjusted largely upward.

This paper uses an administrative data set on 19 250 Swedish siblings from 8 684 families to investigate the effects of college type on annual earnings.[6] Friends, parents and other family members might influence the decision to go to a particular college. An advantage with the data is that they allow us to control for unobserved family and neighborhood characteristics that may affect college choices. This analysis is based on observations that have within-family variation in college choice. Several reasons explain why siblings from the same family might choose different colleges. One is that a college was established before one of them made their decision to go to college.[7] Another reason might be that they have different high-school grades. Yet another reason might be that one sibling chooses a different college because of the (low) quality of the college education obtained by another sibling.

In contrast to Altonji and Dunn (1996) who use siblings to estimate the effects of high-school quality, we can identify whole and half siblings. We conduct separate analyses of whole siblings, whole siblings reared together, sisters and brothers. This means that we can examine the importance of family background along several dimensions.

The results show that earnings vary significantly between students who graduated from different colleges and between different samples of siblings. The cross-sectional estimates are up to twice the within-family estimates, showing that a regression estimator of college effects that does not adjust properly for family characteristics will overestimate the earnings premium of college type. Nonetheless, the results show a significant relationship between college type and earnings when we control for area of residence after college education.

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[6] There are two previous Swedish studies. Wadensjö (1991) examines whether earnings vary among students (with degrees in some specific field) from seven different colleges. Gustafsson (1996) examines whether earnings effects from degrees in economics vary between students from all colleges. Both studies find a significant relationship between college type and earnings, but none controls for family background.

[7] We do not know when individuals start their college education, so we cannot identify which colleges existed when they made their decisions.

2. Institutional background

In 1965, Sweden had only five universities[8] that provided higher education within most academic fields.[9] In the 1960s, the number of students at the universities increased rapidly, especially those who majored in arts and social sciences. Enrollment restrictions, and formal application procedures did not exist, and the universities soon reached their capacities. To meet the increased demand for higher education, the government decided to establish new colleges.[10] During their launch years, new colleges mainly provided first-year education in some of the arts and social sciences subjects.[11] As they became formally established, the colleges began providing second- and third-year education.

In 1977, 12 new colleges[12] were established and situated in parts of the country with limited traditions of higher education. In the same year, the government decided that one administrative authority on the national level should handle admissions to education at all colleges and that general and specific admission requirements should determine admission to undergraduate education. Students fulfilled the general requirement if they had either completed at least two years of high-school education or were at least age 25 and had more than four years of work experience or had at least 11 years of education from abroad. Many courses had a special admission requirement of at least three years of high school education in key subjects for a particular field/major. The admission requirements for a program were identical across colleges.

The admission requirements have changed over time, but there are no major differences between those that are valid today and those described above. The national authority still processes applications to programs at most universities. Further, the government regulates the number of students at each university. The number of

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[8] University and college is used interchangeably throughout this paper. In Sweden, a university provides doctoral education in all academic fields, while colleges do not. There are a few semi-private colleges but they receive grants from the government, and must follow, *e.g.* stipulated rules for admission.

[9] These were Lund, Gothenburg, Stockholm, Uppsala and Umeå universities. There were also three specialized institutions; Chalmers University of Technology, Royal Institute of Technology and Stockholm School of Economics.

[10] Lulea Institute of Technology was established in 1970 and Linköping University in 1975.

[11] Linköping, Växjö, Örebro and Karlstad Colleges began providing education in the 1960s but were formally established in the 1970s. In 1999, Växjö, Örebro and Karlstad became universities.

[12] Borås, Falun/Borlänge, Gävle/Sandviken, Kalmar, Karlstad, Kristianstad, Växjö, Örebro, Östersund Eskilstuna/Västerås, Sundsvall/Härnösand and Jönköping.

applicants is practically always higher than the number of educational slots, which means that the high school grade-point averages required for admission can be high for many programs. Generally, the number of applicants is higher at traditional universities than at recently established universities. So the high school grade-point average is higher at traditional universities.

In 1977, all higher education was organized into an overall concept of higher education that encompasses traditional university education and studies at various professional institutes (*e.g.,* nursing and preschool teaching) and programs taught at a level between upper secondary and college levels. Generally, the traditional university education was organized into long-term programs (3 years or more) and the *new* higher education into short-term programs (2 years or less). The former programs prepared for research in a particular academic field while the latter program provided vocational academic training.

During the 1977-1993 period, the parliament and the government regulated the higher education system in detail. For example, they determined the curriculum, the number of students in every program and the organization of the departments at each university. They also appointed senior lectures and professors. Since 1993, decisions about these issues have successively been handed over to the colleges. Three new colleges were established in the 1980s, and three in the 1990s.[13] In 1999 the government decided to further increase the number of study slots, particularly at newly established universities and colleges.

In contrast to colleges in the US and many other European countries, there are no tuition fees at Swedish universities. Students pay only a small obligatory annual fee of about SEK 600 (USD 60) to the student union. The government provides universal financial support for all students. The support consists of two parts: study grants and study loans, which in combination constitute *student aid*. The student aid amounts to SEK 6 476 (USD 648) per month in 2001. Parent's income or wealth does not affect the

[13] Halmstad, Karlskrona/Ronneby and Skövde in the 1980s, Trollhättan/Uddevalla, Malmö, Södertörn and Gotland in the 1990s. Mitthögskolan, Mälardalen and Dalarna were also established in the 1990s, but they are mainly mergers of colleges established in the 1970s and 1990s. In the 1990s, some colleges for health sciences have been incorporated into the state-run colleges.

amounts that students receive. The system of student aid has gone through some changes since the 1960s. Generally, the accessibility to student aid and the level of the loans improved, while the terms of re-payment were restrained.

3. Empirical models

Consider the earnings equation:

$$Y_{ij} = X_{ij}\beta + C_{ij}\alpha + v_j + v_{ij} \qquad (1)$$

where Y_{ij} is the logarithm of annual earnings for individual i in family j, X_i is a vector of individual characteristics including gender, age, age-squared, education level and field/major.[14] C_{ij} is a vector of dummy variables of college type and v_j and v_{ij} are unobserved family and individual-specific components. If C_{ij} were allocated independently of the unobserved variables, ordinary least squares on equation (1) provides unbiased estimates of the returns to college type. But students who graduate from a particular college may live in better neighborhoods or otherwise have an advantageous family background, which is likely to affect future income. If the researcher does not observe these advantages, then the conventional cross-sectional estimates of α will probably be upward biased.

Sibling data provide one opportunity to control for unobserved family background and neighborhood characteristics. More accurately, such data adjust for any bias caused by factors shared by siblings. These shared factors include, for example, parental socioeconomic status, other parental characteristics, interactions among children that induce sibling resemblance, shared community factors (such as school quality) and socioeconomic status of neighbors.

In contrast to the identical twins approach, siblings data do not adjust for bias related to unobserved individual-specific factors that are fixed over time.[15] But use of

[14] There are significant wage differentials between individuals who majored in different subjects, which points at the importance of including dummy variables of fields of study as control variables.
[15] See Griliches (1979) and Solon (1999) for a more thorough discussion of potential problems with sibling data.

twin data would be no option here because limited sample sizes would not allow an analysis of college quality.[16] However, a strong positive correlation exists between school grades and family background in Sweden, see, for example, results reported from Skolverket (1999). So one might expect that the within-family estimator removes part of the bias due to fixed sibling effects.

This model adjusts for bias due to unobserved factors shared by siblings:

$$\Delta Y_{ij} = \Delta X_{ij}\beta + \Delta C_{ij}\alpha + \Delta v_{ij} \qquad (2)$$

where Δ indicates deviations from family means and v_j is eliminated because it is constant within the family. α measures the average earnings effect of graduating from a particular college compared to a reference college. Altonji and Dunn (1996) used this approach when estimating the earnings effects of high-school quality in the US.

Theoretical and empirical literature show that sibling composition can influence children's educational attainment and subsequent earnings (*e.g.* Behrman *et al.* 1982, Becker 1991, Butcher and Case, 1994, Hauser and Kuo, 1998). Our data allow various analyses of sibling composition, but in this paper, we focus on whole siblings because they are more likely to have similar innate ability and family backgrounds than half siblings.[17] We also make separate analyses on brothers and sisters and on siblings who grew up together. Siblings of the same sex may share more when growing up than a brother and a sister, which implies that they might have more of the unobserved family component in common. Bound *et al.* (1986) report results that are in line with this hypothesis. They find that the sister-sister correlation in wages is 0.34, while the sister-brother correlation is 0.07. Similar results are reported in Solon *et al.* (1991), and Altonji and Dunn (1991). Solon (1999) argues that these findings are results of different labor supply behavior among men and women.

[16] Isacsson (1999) uses the Swedish twin registry to study the return to schooling. Rosenzweig & Taubman (1996) use data on 709 pairs of female twins born in Minnesota to estimate effects of college quality in the US.

[17] It seems as if Altonji and Dunn (1996) and Ashenfelter and Zimmerman (1997) could not distinguish between whole and half siblings.

Perhaps a new college, just because it is new, attracts only students who cannot meet traditional university requirements, which introduces a negative bias in the estimates.[18] But it is also possible that a new university attracts similar types of students compared to traditional universities. For example, if the new university is closer to home than a traditional university, then students can save money by living at home while studying for their college degrees. Because new colleges receive generous funding, which can be invested, for example, in computers, libraries, office space, teaching facilities, they might be relatively more attractive than older universities. These aspects of new colleges could affect students' choices even though they meet requirements at all colleges.

Studies on the relationship between education and earnings discuss the problem of different types of measurement errors (e.g. Griliches 1979, Ashenfelter and Krueger 1994, Kane *et al.* 1997, Bound and Solon 1999). It has been argued that differences between within-family estimates of the return to education and cross-sectional estimates might be due to measurement error in education and omitting unobserved family components from the earnings equation. Also, it has been pointed out that the problem with measurement errors becomes aggravated when using within-family variation.

Naturally, any variable can be measured with errors. But in Sweden, colleges must report individual data on education and college type to Statistics Sweden, using the same administrative method. If there are measurement errors in any variable related to education, these errors are probably identical across colleges. The main interest in this study is to investigate if there are differences in earnings after graduation from different colleges and not to estimate the level of the returns from education. So potential measurement errors in the within-family analyses are not likely to affect the comparison of colleges.

4. The data

The database used in this study was constructed from administrative records kept by Statistics Sweden. It covers a random sample of 100 000 individuals who were born in

[18] See Öckert (2001) for discussions of administrative selection and analyses of the consequences of failing to adjust for this type of selection when estimating the earnings premium to university education.

Sweden between 1951 and 1964 (see Björklund *et al.* 2002). Siblings of these individuals were located in two registers; the second generation register was used to locate biological siblings, biological "whole siblings", half siblings on mother's side, and half siblings on father's side. Censuses of 1960, 1965, 1970, 1975 and 1980 were used to find households in which individuals were living as children (age 0-17 years).

Annual earnings and other work-related data come from registers based on employers' compulsory reports to tax authorities and cover the years 1987, 1990, 1993 and 1996. Information on highest completed level of education, field/major and place of education come from the education register, which contains attained degrees that the colleges reported to Statistics Sweden. Colleges are required to report to Statistics Sweden, which means that the register contains the same educational information on students at every university. 23 colleges are included in the analyses and among these, Lund, Gothenburg, Stockholm, Uppsala and Umeå were established first and are referred to as *old colleges* .

We impose some restrictions on the samples that we use for estimations. We use observations on biological whole siblings born in Sweden who are college graduates[19] and earn more than SEK 100 000 in 1996.[20] We also require at least two college graduates from each family. Finally, we exclude siblings who have a degree from college but no information on place of education.[21] These restrictions leave us with a sample of 19 250 individuals (including 400 twins), from 8 684 families, referred to as the *basic sample*.

In contrast to previous studies, our data allow detailed analyses of the siblings' living arrangement when growing up. For example, we can identify siblings who lived most of their time together and siblings who lived together for a few years only. Moreover, we know if they grew up with only a mother, a father or both their parents. In this paper,

[19] We also analysed families with high school graduates and only one college graduate. The sample size is much larger and allows controls for high school grades. The results are about the same as those reported in this paper. Further, differences in high school grades do not explain the college effects.
[20] Antelius and Björklund (2000) show that the effects of education on annual earnings with this restriction are close to those obtained using hourly wages. The income restriction reduced the sample by 25%.
[21] Missing data on place of education reduced the sample by 11%. We examined theese 11% and we found no differences in age, level or field/major compared to individuals for whom place of education is available.

we investigate siblings who are observed in the same household with both parents or with either one of them (but the same parent) in all censuses.[22] This is our *same household* sample.

Table 1 reports descriptive statistics of the samples used in estimation. The samples of sisters and brothers include only individuals who have at least one sibling of the same sex, which explains why the number of observations does not add up to those of the basic sample. Identification of the college-type coefficient based on the within estimator comes from families in which the colleges were different. Siblings attended different colleges in 62% of the families in the basic sample. In the samples of sisters and brothers, sisters choose different colleges to a larger extent. The next row shows the proportion of families in which at least one sibling attended an old college and at least one attended a new college and naturally, this proportion is considerably smaller.

The table also reports the distribution of individuals over eight broad education fields. About 50% of the individuals in the basic sample have an education in industry, trade, technology, natural science and administration, economics, social science and behavioral science. Other large groups are health care and education (teachers training). There are large gender differences in choices of field. Women majored in health care and education, while men majored in technology. So it is important to control for field when estimating the relationship between college type and earnings. We follow previous Swedish studies and include ten broad categories of fields.[23]

<TABLE 1 about here>

[22] We also analyzed siblings who are required to have lived in the same household their whole childhood, (rather than being required to have lived in the same household as the parents - as in the present study) but the results are about the same as those reported for this sample.

[23] One problem in the analysis is that not all educations are available at every college, for example, law is only available at the old universities.

5. Results

Table 2 reports estimated cross-sectional and within-family earnings premiums of college type for the basic sample and for sisters and brothers separately.[24] The control variables are age, age-squared, gender, education level and field.

<TABLE 2 about here>

The first row reports estimates from regressions run at an aggregated level, where *old university* refers to the universities in Uppsala, Lund, Stockholm, Gothenburg and Umeå. Other rows report separate effects of all universities/colleges included in the data, with Luleå University as reference category. The cross-sectional estimates reported in column 1 show that there is a significant relationship between college choice and earnings. At the aggregated level, the 0.07 estimate indicates a 7% average earnings premium differential from graduating from an old university. At the disaggregated level, the estimated earnings premium varies between -7% and +10%, where the lowest estimate refers to Jönköping and the highest estimate to Stockholm. Individuals who graduated from universities in Uppsala, Lund, Stockholm, Gothenburg and Linköping earn significantly more than those in the reference category. There is an earnings premium of about -5% of attending colleges in Örebro and Mitthögskolan, while some colleges have similar negative earnings premiums that are nearly significant. Based on annual earnings of SEK 235 000 (USD 23 500), 5% amounts to about SEK 11 750 SEK (about USD 1 175) per year. This is more money than the yearly mortgage on the governmental student loans, which during our study was 4% of annual earnings or about SEK 10 000.

The within-family estimates in column 2 show that a regression estimator of college effects which does not adjust for family and neighborhood characteristics will be biased upwards. The within-family estimate at the aggregated level is about half the cross-sectional estimate. At the disaggregated level, the positive estimates become less positive while the negative estimates become slightly more negative. The within family estimates for Stockholm is reduced by more than 50%.

[24] Complete regression results are available from the authors.

Same-sexed siblings might share more when growing up than siblings of different sexes. For example, boys might play with other toys at different playgrounds than girls, and they might choose other friends. These early influences might affect their choice of college later in life. So analyses based on sister-brother comparison may not adjust properly for family and community factors.

The cross-sectional estimates in table 2 show that there are differences between sisters and brothers. The estimates for *old university* are about the same as in the basic sample, but at the disaggregated level, there is a significantly positive relationship between the old colleges and earnings for brothers only. Furthermore, the estimates of the new colleges are negative for sisters but not for brothers. So, a distinct gender difference is revealed only at the disaggregated level. The within family estimates are lower than the cross-sectional estimates for both brothers and sisters.

Sensitivity analyses

Siblings who grew up together probably share more of unobserved family and community characteristics than siblings who grew up apart. If this is true, one might expect that within-family estimators, based on samples of siblings who are reared together, adjust for a larger part of the unobserved family component than estimators based on samples that include siblings who are not reared together. The first two columns of table 3 report results for siblings reared together.

<TABLE 3 about here>

The cross-sectional estimate of *old university* increased slightly, compared to the result in table 2. But the within-family estimate is rather unchanged, which generates a larger difference between the cross-sectional and within-family estimate in this subsample. At the aggregated level, the positive estimates are slightly larger in the cross-sectional and the within-family regressions, compared to table 2. Among the negative estimates, only Jönköping is still significant. Yet, the general pattern remains.

The level of earnings is higher in big-city regions than in other parts of Sweden. If persons at some colleges systematically choose to work in low-paying regions, then the

choice of labor market might explain earnings differentials between students who graduated from different colleges. We know where all individuals resided in 1990, which is strongly correlated with area of work. Using this information, we run separate regressions for a subsample of individuals who had degrees in 1990.

Columns 3 and 4 in table 3 show results from cross-sectional regressions of earnings on college type, with and without dummies for area of residence.[25] Comparing these columns at the aggregated level, we see a reduction of the point estimate when we control for area of residence. Obviously, choice of college correlates with choice of labor market. The estimates at the disaggregated level are also reduced when area of residence is added to the regression. Finally, the last column reports results from within-family regression controlling for area of residence. The within-family estimates are lower than the corresponding estimates in table 2. Still there is a significant relationship between college type and earnings.[26] In all, these results suggest that choice of labor market does not fully explain the estimated earnings differential between students who graduated from different colleges.

As mentioned in section 1, the percentage of the teaching staff with doctoral degrees at Swedish colleges varies between 20% and 70% (National Agency for Higher Education, 2001). Quality of education at different colleges might correlate with the formal qualifications of teachers. If this is correct, then we should see a reduction of the college type effects when the Ph.D rate is included in the regression analysis. A variable that equals the Ph.D. rate at the different colleges is added to equations 1 and 2. Table 4 presents results from this exercise and we see that the college type effects are lower. The cross-sectional estimate of old university is not statistically significant and the within-family estimate is close to zero. These results indicate that formal qualifications of teachers might explain earnings differences among students who graduate from different colleges.

[25] At the aggregated level, the variable is one if the area of residence is the counties of Uppsala, Lund, Stockholm, Gothenburg or Umeå and zero otherwise.

6. Summary and concluding remarks

This study exploited differences in college choice between siblings to investigate the relationship between college type and earnings. In contrast to previous studies, our data allowed identification of whole siblings and separate analyses of siblings reared together, sisters and brothers. In contrast to previous Swedish studies, we control for selection that is connected to family background. The results show that earnings vary significantly between students who graduated from different colleges and between different samples of siblings and the earnings differential is in favor of the old universities. The cross-sectional estimates are up to twice the within-family estimates, which shows that a regression estimator of college-type effects that does not adjust properly for family characteristics, will overestimate the earnings premium differential among colleges. The within-family earnings premium ranges from –8.7% to +5.8%, where –8.7% indicates that the average income is 8.7% lower than the income level of students in the reference category (Luleå).

According to economic theory, these results can emerge if there are institutional differences (*e.g.* quality of education, quality of staff) or if employers use college type to screen prospective employees. This may be due to either real quality differences between colleges or lack of information about the education provided by the colleges. To test the hypothesis that these differences are due to varying quality of education, we add the proportion of teachers with doctoral degrees as an explanatory variable. The finding is that the positive effect of going to an old university is largely reduced and insignificant, which indicates that the differences in earnings premium found in the paper may be interpreted as an effect of varying teaching quality at the colleges in Sweden.

Further, we find that the estimated earnings premium varies between brothers and sisters, which suggests that it is important to compare siblings of the same gender. One possible interpretation of the gender difference is that colleges send different signals for men and women. Since we control for fields of study, specialization in gender-specific education cannot explain these results and neither can the gender composition at colleges.

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[26] Gustafsson (1996) finds that area of residence does not explain the earnings differences among students with degrees in economics from different colleges.

Our results show that earnings vary among students who graduated from different colleges even when we control for family background and area of residence. Identifying mechanisms that lead to these effects is an important question for further research. As a starting point one can collect more college quality indicators and investigate whether they can help explain the earning differences among students from different colleges. One should also consider exploiting different types of data. For example, data on administrative selection into colleges include information on individual preferences of colleges and student quality, which can make it easier to identify the "true" college effects.[27] Another approach is to compare students who have degrees from a new college and students who have taken most of their courses from the same college but received degrees from an old college. The decision to graduate at an old college might correlate with the signal a college sends on the labor market.[28] Moreover, it is important to analyze whether the effects of college type vary over time.

[27] Öckert (2001, 2002) used such data to analyze the wage premium of college education.
[28] Naturally, changes of colleges can also be related to quality of the education. But one might expect that quality-related changes are made in the beginning of a college period - not in the end.

References

Altonji, J., and Dunn, T., 1996, Using siblings to estimate the effect of school quality on wages. *Review of Economics and Statistics*, 78(3), 665-671.

Ashenfelter, O., and Zimmerman, D. 1997. Estimates of the returns to schooling from sibling data-fathers, sons and brothers. *Review of Economics and Statistics*, 79(1), 1-9.

Angrist, J., and Krueger, A., 1999. Empirical strategies in labor economics. In Ashenfelter, O. and Card, D. (eds) *Handbook of labor economics*.

Arai, M., and Kjellström, C, 1999. Returns to human capital in Sweden. In Asplund, R. and Telhado Pereira P. (eds.) *Returns to human capital. in Europe*.

Antelius, J, and Björklund, A, 2000. How reliable are register data for studies of the return to schooling? An examination of Swedish data. *Scandinavian Journal of Educational Research*, 44(4), 341-355.

Behrman, J., Rosenzweig, M., and Taubman P., 1996. College choice and wages. Estimates using data on female twins. *Review of Economics and Statistics*, 78(3), 672-685.

Björklund, A., 2000. Education policy and returns to education. *Swedish Economic Policy Review*, 7(1), 71-105.

Björklund, A., Eriksson, T., Jäntti, M., Raaum, O., and Österbacka E., 2002. Brother correlations in earnings in Denmark, Finland, Norway and Sweden compared to the United States. *Journal of Population Economics*, 15, 757-772

Bound, J. and Solon, G., (1999), Double trouble: On the value of twins-based estimation of the return to schooling. *Economics of Education Review, 18, 169-182*.

Brewer, D., Eide, E., and Ehrenberg, R., 1999. Does it pay to attend an elite private college? *Journal of Human Resources*, 34(1), 105-123.

Card, D., 1999, The casual effect of education on earnings, in *Handbook of labor economics*. Ashenfelter, O. and Card, D. (eds)

Dale Berg, S., Krueger, A., 2002, Estimating the payoff to attending a more selective college. An application of selection on observables and unobservables. *Quarterly Journal of Economics*, 117(4).

Datcher Loury, L., Garman, D., 1995, College selectivity and earnings. *Journal of Labor Economics*, 13(21), 289-309.

Griliches, Z 1979. Sibling models and data in economics: beginnings of a survey. *Journal of Political Economy,* 87(5), 37-64.

Gustafsson, L. 1996. Vilken högskola är bäst? En empirisk analys av de svenska ekonomutbildningarna. (*Which college is the best? An empirical analysis of the education of economists in Sweden*). Bakgrundsfakta till arbetsmarknads- och utbildningsstatistiken 1996:1, Statistics Sweden

Isacsson, G. 1999 Estimates of the return to schooling in Sweden from a large sample of twins. *Labour Economics, 6(4), 471-489.*

Kane, T., Rouse, C. and Staiger, D. (1997), Estimating the returns to schooling when schooling is misreported, Manuscript.

Kjellström, C., Regnér, H. 1999 The effects of geographical distance on the decision to enroll in university education. *Scandinavian Journal of Educational Research, 3(4), 335-348*.

National Agency for Higher Education (2001), Swedish universities and university colleges, annual report

Monks, J., 2000. The returns to individual and college characteristics. Evidence from the national longitudinal survey of youth. *Economics of Education Review,* 19(3), 279-289.

OECD, 2000. Education at a glance. OECD: Paris

Skolverket, 1999. Ämnesproven skolår 9 1998. Analys av resultaten (*National tests of students in last year of compulsory school 1998. Analyses of test results*). Rapport 99:454.

Solon, G. (1999), 'Intergenerational mobility in the labor market', in O. Ashenfelter and D. Card (eds) Handbook of Labor Economics, Vol. 3, Elsevier Science, Amsterdam, 1761-1800.

Wadensjö, E. 1991. Högre utbildning och inkomster (*Higher education and earnings*). Expertrapport nr. 4 till produktivitetsdelegationen. Stockholm: Fritzes.

Öckert., B., Regnér, H. 2000. Högre utbildning i Sverige. En problemorienterd diskussion om utbildningssatsningar (*Higher education in Sweden. A discussion of recent public investments in education*). Rapport till Riksdagens Revisorer (*Report to the Parliamentary Auditors).*

Öckert., B. 2001. Effects of higher education and the role of admission selection. *Dissertation series no. 52.* Swedish Institute for Social Research, Stockholm University.

Öckert., B. 2002. Do university enrollment constraints affect education and earnings? Working Paper 2002: 16 Institute for Labor market policy evaluation.

Table 1 Sample characteristics. Standard deviations within parentheses.

	BASIC SAMPLE	SISTERS	BROTHERS	SAME HOUSEHOLD
Families in which at least two siblings attended different colleges, %	62.6	63.9	55.1	63.4
Families in which at least one sibling attended an old college and at least one attended a new college, %	35.5	35.9	29.0	34.4
Women, %	49.9			49.6
Annual earnings	268 (170)	208 (84)	333 (208)	284 (188)
Log annual earnings	12.4 (0.4)	12.2 (0.3)	12.6 (0.4)	12.4 (0.45)
Age	38.8 (5.8)	38.9 (5.8)	39.0 (6.0)	41.7 (4.9)
College education < 3 years, %	42.3	47.3	36.5	38.7
College education 3 years or longer,%	57.7	52.7	63.5	61.3
FIELD/MAJOR, % {FREQ}				
Fine arts, humanities and religion	4.9 {765}	4.4 {251}	3.8 {223}	4.2 {398}
Education (K-12, etc.	21.4{4121}	32.5{1866}	11.2 {656}	22.8 {2143}
Administration, economics, social science and behavioral science	23.3{4490}	21.6{1238}	23.4 {1373}	22.5 {2117}
Industry and trade, technology and natural science	24.9{4784}	6.9 {393}	42.2 {2470}	22.1 {2074}
Transport and communication	0.6 {112}	0.1 {6}	1.0 {59}	0.6 {60}
Health care	20.6{3970}	32.1{1838}	10.5 {613}	22.1{2071}
Agriculture, gardening, forestry and fishing	2.0 {375}	1.1 {60}	2.9 {170}	2.3 {213}
Service and military sector	3.2 {606}	1.3 {77}	4.8 {281}	3.9 {300}
# families	8 684	2 713	2 772	4356
# individuals	19 250	5 733	5 857	9 391

NOTE: These figures do not deviate much when individuals from old and new colleges are analyzed separately.

Table 2 Cross-sectional and within-family estimates of the effects of college type on annual earnings. Old universities are: Uppsala, Lund, Stockholm, Gothenburg and Umeå.

	BASIC SAMPLE		SISTERS		BROTHERS	
COLLEGES	Cross-section	Within family	Cross-section	Within family	Cross-section	Within family
Aggregated level:						
Old university	**0.071 (0.006)**	**0.042 (0.006)**	**0.068 (0.009)**	**0.040 (0.009)**	**0.064 (0.012)**	**0.031 (0.013)**
Disaggregated level:						
Luleå	*reference category*					
Uppsala	**0.085 (0.017)**	**0.058 (0.020)**	0.048 (0.027)	0.031 (0.034)	**0.114 (0.034)**	**0.104 (0.040)**
Lund	**0.045 (0.017)**	0.019 (0.021**)**	-0.041 (0.026)	-0.065 (0.035**)**	**0.109 (0.033)**	**0.101 (0.041)**
Stockholm	**0.101 (0.016)**	**0.040 (0.019)**	0.047 (0.025)	0.026 (0.033)	**0.144 (0.031)**	0.061 (0.038)
Gothenburg	**0.056 (0.016**)	0.034 (0.020)	-0.012 (0.026)	-0.037 (0.034)	**0.118 (0.032)**	**0.094 (0.039)**
Umeå	-0.014 (0.018)	-0.015 (0.020)	-0.015 (0.028)	-0.042 (0.033)	-0.001 (0.036)	0.032 (0.040)
Linköping	**0.067 (0.018)**	**0.064 (0.021)**	-0.016 (0.029)	0.026 (0.037)	**0.142 (0.035)**	**0.116 (0.041)**
Mälardalen	0.021 (0.023)	0.001 (0.070)	-0.038 (0.040)	-0.079 (0.048)	**0.092 (0.046**)	**0.167 (0.055)**
Jönköping	**-0.073 (0.022)**	**-0.087 (0.026)**	**-0.087 (0.034)**	**-0.103 (0.040)**	-0.040 (0.047)	-0.018 (0.054)
Växjö	-0.015 (0.026)	-0.033 (0.029)	**-0.084 (0.039)**	**-0.101 (0.046)**	0.023 (0.059)	0.014 (0.063)
Kalmar	-0.051 (0.026)	-0.037 (0.030)	**-0.127 (0.039)**	-0.068 (0.047)	0.024 (0.054)	0.053 (0.059)
Kristianstad	-0.021 (0.028)	-0.033 (0.029)	-0.046 (0.030)	-0.088 (0.046)	-0.028 (0.067)	-0.045 (0.073)
Borås	-0.023 (0.024)	-0.039 (0.026)	**-0.088 (0.034)**	-0.077 (0.041)	0.014 (0.062)	-0.028 (0.066)
Karlstad	-0.039 (0.022)	0.018 (0.027)	-0.029 (0.033)	-0.052 (0.042)	**0.098 (0.047)**	**0.128 (0.055)**
Örebro	**-0.051 (0.020)**	**-0.064 (0.023)**	-0.059 (0.031)	-0.041 (0.038)	-0.036 (0.042)	-0.095 (0.048)
Dalarna	0.004 (0.027)	-0.019 (0.031)	-0.063 (0.040)	-0.092 (0.048)	-0.060 (0.059)	-0.023 (0.068)
Gävle/Sandv	-0.017 (0.025)	-0.057 (0.029)	-0.058 (0.036)	**-0.100 (0.043)**	0040 (0.065)	0.072 (0.073**)**
Mitthögskolan	**-0.043 (0.021)**	-0.025 (0.024)	**-0.073 (0.032)**	-0.040 (0.039)	-0.003 (0.041)	0.021 (0.048)
Karlskr/Ron	-0.038 (0.033)	-0.002 (0.046)	-0.089 (0.072)	**-0.190 (0.077)**	0.034 (0.079)	0.188 (0.106)
Halmstad	-0.056 (0.032)	-0.007 (0.038)	**-0.103 (0.051)**	-0.083 (0.064)	0.041 (0.073)	0.025 (0.083)
Skövde	-0.056 (0.032)	-0.012 (0.037)	**-0.122 (0.053)**	-0.087 (0.060)	0.013 (0.066)	0.090 (0.077)
Malmö	0.034 (0.026)	0.011 (0.029)	-0.042 (0.042)	0.049 (0.050)	0.083 (0.053)	0.087 (0.058)
Uddevall/Trollh	-0.011 (0.038)	0.012 (0.041)	-0.046 (0.061)	0.008 (0.062)	0.025 (0.085)	0.062 (0.098)
SAMPLE SIZE	19 250	19 250	5 733	5 733	5 856	5 856

NOTE: Standard errors in parentheses. Regressions also include an intercept and control variables for age, age-squared, gender, education level and field/major. Bold values show estimates that are statistically significant at the 5 % level.

Table 3 Estimates of the effects of college type on annual earnings for siblings reared together and for siblings with a college degree in 1990, controlling for area of residence.

	SAME HOUSEHOLD		SIBLINGS WITH A COLLEGE DEGREE IN 1990		
COLLEGES	Cross-section	Within family	Cross-section	Cross-section c. f. area of residence	Within family c. f. area of residence
Aggregated level:					
Old university	**0.081 (0.009)**	**0.040 (0.009)**	**0.055 (0.006)**	**0.034 (0.006)**	**0.025 (0.006)**
Disaggregated level:					
Luleå	*reference category*				
Uppsala	**0.107 (0.026)**	**0.105 (0.030)**	**0.066 (0.017)**	**0.052 (0.018)**	**0.043 (0.020)**
Lund	0.047 (0.025)	0.060 (0.031)	0.029 (0.017)	0.029 (0.019**)**	0.016 (0.021)
Stockholm	**0.115 (0.024)**	**0.075 (0.029)**	**0.089 (0.016)**	0.022 (0.017)	**0.039 (0.019)**
Gothenburg	**0.062 (0.025)**	**0.073 (0.030)**	**0.041 (0.016**)	**0.039 (0.018)**	0.009 (0.020)
Umeå	-0.003 (0.027)	-0.008 (0.030)	-0.007(0.018)	-0.016 (0.019)	-0.026 (0.020)
Linköping	**0.081 (0.027)**	**0.124 (0.032)**	**0.056 (0.018)**	**0.055 (0.020)**	**0.044 (0.022)**
Mälardalen	0.006 (0.038)	-0.011 (0.043)	0.012 (0.023)	-0.003 (0.025)	-0.031 (0.027)
Jönkoping	**-0.096 (0.034)**	**-0.083 (0.038)**	-0.033 (0.022)	-0.026 (0.024)	-0.043 (0.026)
Växjö	-0.037 (0.040)	-0.031 (0.043)	0.011 (0.026)	0.018 (0.028)	-0.026 (0.030)
Kalmar	-0.070 (0.040)	0.015 (0.044)	-0.017 (0.026)	-0.013 (0.028)	-0.020 (0.031)
Kristianstad	-0.017 (0.042)	-0.015 (0.045)	-0.006 (0.028)	0.007 (0.030)	-0.025 (0.032)
Borås	-0.045 (0.036)	-0.023 (0.040)	-0.034 (0.024)	-0.044 (0.026)	**-0.072 (0.027)**
Karlstad	0.045 (0.035)	0.059 (0.042)	0.015 (0.022)	0.004 (0.025)	0.003 (0.027)
Örebro	-0.040 (0.031)	-0.011 (0.035)	-0.017 (0.020)	-0.025 (0.022)	**-0.051 (0.023)**
Dalarna	0.010 (0.041)	0.078 (0.047)	-0.035 (0.026)	-0.045 (0.025)	-0.035 (0.031)
Gävle/Sandv	0.002 (0.038)	0.035 (0.044)	-0.014 (0.026)	-0.007 (0.028)	-0.029 (0.030)
Mitthögskolan	-0.049 (0.032)	0.002 (0.036)	**-0.048 (0.021)**	**-0.060 (0.022)**	-0.036 (0.024)
Karlskr/Ron	-0.104 (0.082)	-0.120 (0.088)	-0.045 (0.042)	-0.064 (0.044)	-0.042 (0.047)
Halmstad	-0.035 (0.064)	0.090 (0.066)	-0.017 (0.035)	-0.039 (0.037)	-0.051 (0.041)
Skövde	-0.079 (0.051)	0.029 (0.055)	-0.043 (0.031)	-0.035 (0.034)	-0.022 (0.037)
Malmö	0.055 (0.038)	0.080 (0.042)	0.023 (0.025)	0.026 (0.026)	0.003 (0.028)
Uddevall/Trollh	0.035 (0.069)	0.096 (0.069)	-0.022 (0.039)	-0.027 (0.040)	0.001 (0.045)
SAMPLE SIZE	9 390	9 390	13 005	13 005	13 005

NOTE: Standard errors in parentheses. Regressions also include an intercept and control variables for age, age-squared, gender, education level and field/major. Bold values show estimates that are statistically significant at the 5% level.

Table 4 Estimates of the effects of college type on annual earnings, controlling for the share of teachers with a doctoral degree.

	Cross-section	Within-family
Aggregated level:		
Old university	0.018 (0.014)	0.005 (0.014)

NOTE: Standard errors in parentheses. Regressions also include an intercept and control variables for age, age-squared, gender, education level and field/major