The Effects of Accessibility to University Education on Enrollment Decisions, Geographical Mobility, and Social Recruitment

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Abstract

This paper focuses on how accessibility to higher education affects university enrollment decisions in Sweden. The analysis refers to the autumn semester of 1996 and is based on approximately 835,000 individuals aged 19−29. The empirical results show that the probability of enrollment increases with accessibility to university education. The findings also reveal that accessibility adds to the likelihood of enrollment within the region of residence. Both these results are robust with regard to different specifications of accessibility. Moreover the empirical results indicate that the enrollment decisions of individuals with a less privileged background are more sensitive to accessibility to university education than those of individuals from a more advantageous background. The influence of accessibility on enrollment decreases significantly with individual ability, parental education, and parental earnings.

Keywords: University enrollment; accessibility; geographical mobility; social recruitment

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1. Introduction

In the last four decades, Sweden has experienced a dramatic expansion of higher education. The number of university entrants has increased from around 10,000 per year in the early 1960s to more than 65,000 per year in the late 1990s. During the same period, we have seen a substantial geographical decentralization of university education, with the establishment of more than twenty new universities and university colleges throughout the country.[1] There were several motives behind the decision to decentralize higher education. One was that the traditional universities did not have the capacity to accommodate the growing number of students. Another reason was to attract students from the lower social classes and thereby reduce the uneven social recruitment into higher education. Yet another argument was founded on regional policy considerations. The establishment of new universities could contribute to a strengthening of regional labor market conditions outside the metropolitan areas and bring out-migration from the economically challenged regions to a halt. Increasing regional disparities during the 1990s have strengthened the regional policy motive, and the geographical spreading of higher education has not only continued but also accelerated.

Considering the development described above, there have been surprisingly few attempts in Sweden to study investments in higher education in a regional or spatial context (two exceptions are Dryler, 1998; and Kjellström and Regnér, 1999). Economists generally have taken a national perspective, and mainly been occupied with estimating the *ex post* returns of investments in higher education rather than directly focusing on the determinants of university enrollment decisions.

The present paper contributes with an explicit spatial perspective on investments in higher education. Two questions are in focus. The first is whether accessibility to higher education affects university enrollment decisions. This question is addressed by introducing several alternative measures of accessibility into a simple spatial extension of the so-called schooling model. The model not only considers the individual's decision whether or not to invest in a university education, but also focuses on the interrelated choice of the regional destination of the investment. The explicit modeling of the regional destination generates important insights into how accessibility influences not only university enrollment decisions in general, but also the geographical redistribution of the population and the stock of human capital. The second question concerns whether the enrollment decisions of people with a less privileged background

[1] See Öckert and Regnér (2000) for an overview of the development of the Swedish system of higher education during the last decades.

are more sensitive to accessibility to university education than those of people from a more advantageous background. This question is addressed by interacting accessibility with individual ability, parental education, and parental earnings.

The empirical analysis refers to the autumn semester of 1996 and is based on a longitudinal micro database that has been created by matching a number of administrative registers at Statistics Sweden (SCB) and the Swedish Labor Market Board (AMS). For this particular study, approximately 835,000 individuals aged 19−29 have been sampled from the database and are used in the econometric estimations. In the specification of the econometric model, it is important to note that the regional destination of the schooling investment can only be observed for those individuals who actually decide to attend university. However, the sample of those who enroll is not necessarily a random sample of the underlying population of persons qualified to attend. Potential problems with sample selection bias are taken into consideration in the econometric specification by employing a bivariate probit model with sample selection.

The empirical findings show that the probability of enrollment increases with accessibility to university education. The results also indicate that accessibility adds to the likelihood of enrollment within the region of residence, or, in other words, accessibility deters schooling induced out-migration. Neither of these findings is sensitive with regard to the exact specification of accessibility. Moreover, the empirical results reveal that the enrollment decisions of persons with a less privileged background are more sensitive to accessibility to university education than those of people from a more favorable background. The influence of accessibility on enrollment decreases significantly with individual ability, parental education, and parental earnings.

The rest of the paper is organized as follows. Section 2 provides a short review of earlier research relevant to this study. A simple model of individual schooling investment decisions is presented in Section 3. This section also contains the econometric specification and a brief discussion of alternative accessibility formulations. Section 4 provides a description of the data and the empirical results are presented in Section 5. Section 6 summarizes the findings and provides some final remarks.

2. Previous studies

Following the pioneering work of Becker (1964) and Mincer (1974), there have been hundreds of studies in many different countries that focus on the economic returns of

investments in education.[2] The number of studies that focus directly on the determinants of schooling investments are, however, more scarce, in particular the ones that study investments in higher education in a regional or spatial context.

The most explicit spatial or regional perspective on investments in higher education can be found in a series of papers that focus on two-year and four-year college enrollment in the United States. The questions these papers deal with include whether college specific tuition costs and geographical distance to college education have any impact on enrollment decisions. Manski and Wise (1983), Weiler (1989), Rouse (1994, 1995), and Ordovensky (1995) are examples of studies based on micro data and controlling for individual ability and family background characteristics. Although the choice variables and the econometric techniques differ somewhat in these papers, the overall conclusion is that the probability of enrollment at both two-year and four-year colleges decreases significantly with tuition fees and distance. The effect appears to be particularly large for enrollment at two-year colleges. There is also some evidence suggesting that students from low-income families are more sensitive to tuition costs and distance. Several studies based on aggregated data, including Grubb (1988), Betts and McFarland (1995), and Kane (1995), confirm the negative effect of tuition costs on college enrollment.

Some of the papers above also examine whether regional labor market conditions influence college enrollment decisions. The empirical support is fairly mixed in studies using micro data and controlling for individual ability and family background attributes. Manski and Wise (1983) focus on applications to four-year colleges and report fairly small effects of regional labor market conditions. The effect of the average regional wage rates is negative and significant while the average regional unemployment rates have no significant influence. Rouse (1994) uses the average regional unemployment rates as a measure of the opportunity cost of attending two-year and four-year colleges and finds positive and significant influences. The effect of various measures of expected returns is, however, quite sensitive with regard to the exact specification. Experience adjusted wage differentials that vary by level of education and region turn out positive and significant for both two-year and four-year enrollment, whereas the average regional wages by educational group are insignificant. Focusing on two-year and four-year college enrollment, Kane (1995) finds that the average regional unemployment rates do not have any significant influence. Ordovensky (1995) reports that the average regional unemployment rates have an unexpected negative and significant effect on

[2] See Psacharopoulos (1994) for an overview of international literature on education and earnings.

enrollment in two-year college academic programs, but no significant influence on enrollment in two-year college vocational programs or four-year colleges.

The ambiguity remains in studies based on aggregated data. For example, Grubb (1988) does not find any significant effects of regional labor market conditions on enrollment at two-year and four-year colleges. In a subsequent paper, however, Grubb (1989) reports evidence of a negative and significant influence of the opportunity cost of attending college when measured by the average regional earnings of high school graduates aged 20−24, but no significant effect when measured by the average regional unemployment rate for the same age group. Various measures of expected returns generally turn out to be insignificant. Focusing on two-year college enrollment, Betts and McFarland (1995) report that the average regional unemployment rates among recent high school graduates have a positive and significant effect, whereas high school graduates' average regional starting wages have a negative and significant impact. Kane (1995) finds that the average regional unemployment rates are positively and significantly related to total college enrollment and public two-year enrollment, but negatively related to public and private four-year enrollment.

There are also a few recent Swedish papers that analyze whether geographical distance to university education influences enrollment decisions. Dryler (1998) focuses on how the establishment of new universities and university colleges influences the social recruitment into higher education. The analysis is not based on any explicit measure of geographical distance. Instead, she examines the development of enrollment rates for different social classes in a group of cities where universities were established in the beginning of the 1970s and compares them with those for a reference group of cities with no universities. She finds no indication of class equalization in enrollment rates as a result of the establishment of new universities or university colleges. This is taken as evidence that people from different social classes do not differ in their sensitivity to geographical distance. Kjellström and Regnér (1999) examines whether geographical distance to the nearest university has any effect on the enrollment decisions of a sample of individuals born in 1948, 1953, and 1967. They report that distance has a negative and significant influence on all three cohorts when controlling only for gender. However, when introduces individual ability and family background characteristics as well, the negative and significant effect of distance remains only for those born in 1967. They also use interaction terms of distance and ability and distance and family background to examine whether the enrollment decisions of persons with a less privileged background are more sensitive to distance than those of people from a more advantageous background. The results do not indicate any such differences in distance sensitivity.

Summing up, studies on college enrollment decisions in the United States report fairly strong evidence of tuition cost sensitivity and distance sensitivity, whereas the effects of regional labor market conditions turn out to be rather mixed. The Swedish studies report ambiguous effects of geographical distance on enrollment decisions and find no evidence that distance matters more for people with a less privileged background than for those from a more favorable background.

3. Analytical framework

This section presents a simple model of individual schooling investment decisions, designed to fix ideas and to provide some justification for the empirical work below. The point of departure is the so-called schooling model (Mincer, 1974). The schooling model focuses on the period in the life cycle in which a person devotes all his time to investment in education, and hence supplies no labor to the market. The core of the model is that individuals who invest in education raise their marginal productivity and, as a consequence, future labor earnings. The model assumes that the individual, in deciding whether or not to invest, makes a rational comparison of the present value of the difference in lifetime earnings, with and without extra education, with the foregone earnings costs and direct costs of spending extra years at school. In his celebrated Woytinsky lecture, Becker (1967) suggested that people differ in the amount invested in human capital primarily because of differences in either "ability" or "opportunity": those with greater ability receive higher earnings from a given investment whereas those with greater opportunity face lower costs in financing the investment. As a result, those with greater ability or cheaper funding are likely to invest more in education than others.

The model presented here is an extension of the standard schooling decision framework in the sense that the investment decision is considered to take place in a spatial context. The individual is assumed to face a set of J region specific schooling investment opportunities. When choosing between the potential investment opportunities, the individual is assumed to consider factors such as the quality and quantity of schooling and consumption opportunities in the regions on the one hand and the transaction costs of investing in a particular region on the other. Save for that schooling is considered an opportunity for location specific consumption; other nonmonetary benefits of education are ignored. The model also abstracts from the demand for leisure and treats the retirement age as independent of years of schooling.

To begin, imagine the dichotomous investment decision facing a high school graduate: to enter the labor force or to proceed to college/university for one year of schooling.[3] Let the per year expected earnings for the two alternatives (indexed *h* for high school and *c* for college/university) for individual *i* residing in region $p \in J$ be given by the following functions:

$$E[Y_{hi}^{p}(t)] = Y_{h}^{p}(1-u_{h}^{p})A_{i} + u_{h}^{p}B_{i} \tag{3.1}$$

$$E[Y_{ci}^{p}(t)] = Y_{c}^{p}(1-u_{c}^{p})A_{i} + u_{c}^{p}B_{i} \tag{3.2}$$

where $E(Y)$ is expected earnings, Y is average market earnings, u is the unemployment rate, A is individual ability, and B is the unemployment benefit. For now, assume that A is a scalar and that higher values of A are associated with higher expected earnings, i.e. $\partial E(Y)/\partial A > 0$. Note also that it is implicitly assumed that people have myopic expectations as they respond to current market earnings and unemployment rates in the region of residence. Undoubtedly, one could experiment with more sophisticated expected earnings formulations. However, given the difficulties and costs associated with acquiring labor market information in distant time and space, the myopic earnings formulation may not be too restrictive.[4]

If a person chooses to enter the labor force immediately after high school graduation he will receive earnings $E[Y_{hi}^{p}(0)]$ during the first year, $E[Y_{hi}^{p}(1)]$ during the next year, and so on until $E[Y_{hi}^{p}(T)]$ during the last year before retirement. If he invests in extra schooling, after the initial period of investment earnings $E[Y_{ci}^{p}(1)]$, …, $E[Y_{ci}^{p}(T)]$ will ensue. Investing in an extra year of education in a particular region $j \in J$ produces a foregone earnings cost and net transaction costs:[5]

$$C_{i}^{pj} = E[Y_{hi}^{p}(0)] + [TC_{i}^{pj}(AC^{p}) - Q_{i}^{j}] \tag{3.3}$$

where C is the total cost of the investment, TC denotes gross transaction costs, and Q represents the monetary equivalent of the quality and quantity of schooling and consumption opportunities in the chosen destination region. The further away from the

[3] The idea of a one-year university education is used to simplify the presentation. Although it ignores the fact that most university programs last several years, it still demonstrates the essential characteristics of all schooling investment decisions.

[4] Also, if one assumes that those individuals choosing to invest *a priori* have not decided in which region to supply their labor, and that the region of residence is a likely alternative for those choosing not to invest, the myopic earnings formulation seems reasonable.

[5] Direct costs of schooling are ignored as university education in Sweden is virtually free of charge.

region of residence the individual has to move in order to find an investment opportunity with the preferred characteristics, the higher the gross transaction costs of investing, because of informational costs and monetary and nonmonetary costs for commuting or migration. For now, assume that gross transaction costs are a function of accessibility to university education in the region of residence, denoted by *AC*, and that higher values of *AC* are associated with lower gross transaction costs, i.e. $\partial TC / \partial AC < 0$.

When calculating the present value of the stream of expected earnings, the individual will apply a constant discount rate, *r*, which is assumed to be a function of his family background characteristics, denoted by *Z*:

$$r_i = r(Z_i) \tag{3.4}$$

The discount rate reflects the individual's opportunity, or the terms on which he can finance the schooling investment. Following Becker (1967), it is assumed that financing opportunities primarily vary between individuals because of differences in the capacity of their families to offer financial support. For now, assume that *Z* is a scalar and that higher values of *Z* are associated with a lower discount rate, i.e. $\partial r / \partial Z < 0$.

In deciding whether or not to invest, the individual makes a rational comparison of the total benefits of an extra year of schooling with the total costs of the investment. The individual is assumed to choose to invest in region j^* from the set of regions *J* if:

$$V_i^{j*}(t) = \left\{ \max_{j \in J} \sum_{t=1}^{T} \frac{E[Y_{ci}^{p}(t)] - E[Y_{hi}^{p}(t)]}{(1+r_i)^t} - C_i^{pj} > 0 \right\} \tag{3.5}$$

where V_i^{j*} is the net present value of investing in an extra year of education in region j^*. Equation (3.5) indicates that the present value of the investment is higher; the larger the difference in expected earnings between university graduates and high school graduates, the lower the discount rate, the younger the investor, and the lower the total cost of the investment. These are the fundamental propositions that follow from the schooling model and the definition of discounted values.

Let us consider in greater detail some of the implications that follow from this simple schooling decision framework. Equations (3.1) and (3.2) suggest that expected earnings not only depend on market earnings and unemployment rates, but are also a function of individual ability. However, it is unclear whether ability actually has an effect on the investment decision because, although the earnings gain from education will tend to be higher for the more able, their foregone earnings cost will be higher to. Nevertheless, if

the effect of ability on productivity and earnings increases with schooling we would expect the more able to be more inclined to invest in education. Further, if education is regarded as an uncertain investment, where the returns are dependent upon the probability of graduation and the value of ability given graduation, the investment decision might also be influenced by differences in family background related ability uncertainty.[6] The individual's uncertainty about his graduation probability and the value of his ability given graduation can be assumed to be greater the more the educational level differs from that of his parent's.[7]

Turning to equation (3.3) and recognizing that expected earnings also are a function of employment opportunities, it follows that the foregone earnings cost of investing will be higher the better the regional labor market situation for high school graduates. However, the opportunity cost of investing will also depend upon the individual's own labor market status at the time of the investment decision. Concerning the net transaction costs of investing in a particular region, these may be negative since they include the monetary equivalent of location specific consumption.[8] By analogy with Mincer's (1978) analysis of household migration, it is also recognized that a person with a spouse and/or children may not be able to pursue his private free optimum when choosing between available investment opportunities. Potential negative private externalities from a family decision therefore increase net transaction costs.

Moving on to equation (3.4) and financing opportunities, these are likely to vary between individuals primarily because of differences in their families' income and wealth. The educational level of the parents may also be of importance in this context, since parental education is probably a better indicator of permanent family income and family wealth than is current family income. However, parental education may also have an effect on the individuals taste and aptitude for schooling. In this particular setting, a person who enjoys learning and has a specific taste for education can be pictured as discounting the returns from the investment at a lower rate, and hence being willing to invest more in education than strict monetary considerations would imply.

Summing up, we may broadly divide the variables assumed to affect the schooling investment decision into four groups. These are variables which reflect: (i) regional attributes; (ii) the individual's family background characteristics; (iii) attributes of the individual; and (iv) characteristics of the individual's household.

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[6] Levhari and Weiss (1974) and Venti and Wise (1983) elaborate on the idea of schooling as an uncertain investment decision. Evidence on the relationship between graduation and earnings is provided by Hartog (1983) and Weiss (1988).
[7] C.f. Sjögren (2000).
[8] C.f. Graves and Linneman (1979).

Econometric specification

The theoretical model presented above is the point of departure for the specification of the econometric model. According to the theoretical model, the individual faces a set of *J* region specific investment opportunities when deciding whether or not to invest in university education. In the econometric model, however, the regional system is from the point of view of the individual simplified to a set of two regions: the region of residence, and the aggregated unit of all other regions.

In the specification of the econometric model, it is important to note that the regional destination of the schooling investment can only be observed for those individuals who actually decide to attend university. However, the sample of those who enroll is not necessarily a random sample of the underlying population of people qualified to attend. Potential problems with selection bias are taken into consideration in the econometric specification by applying an extension of Heckman's (1979) classical sample selection model in a bivariate probit setting. The bivariate probit model with sample selection was introduced by van de Ven and van Praag (1981) and is also presented in Greene (1998, 2000).[9]

Given the simplified regional structure, we observe the outcome of two simultaneous investment decisions: the individual's choice whether or not to invest in a university education and the interrelated decision whether to invest at a university within or outside the region of residence. In the theoretical model, it is assumed the individual selects the most attractive investment alternative. Although the net present value of the different alternatives is unobservable, the observed choice reveals which one provides the highest net present value.

Let V_{1i} indicate empirical observations of the individual's decision whether or not to invest in university education, where $V_{1i} = 1$ if enrollment is observed and $V_{1i} = 0$ otherwise. Similarly, let V_{2i} denote empirical observations of the individual's choice whether to invest at a university within or outside the region of residence, where $V_{2i} = 1$ if enrollment within the region of residence is observed and $V_{2i} = 0$ otherwise. Obviously, V_{2i} is observed only if $V_{1i} = 1$. The latent variables V_{1i}^* and V_{2i}^* are determined by the independent variables as discussed in the previous section, here represented by the vectors X_{1i} and X_{2i}. This gives the following general specification of the econometric model:

[9] See also Meng and Schmidt (1985) for a discussion of similar models.

$$
\begin{aligned}
&V_{1i}^{*} = X_{1i}\beta_1 + \varepsilon_{1i} \\
&V_{1i} = 1 \text{ if } V_{1i}^{*} > 0,\ V_{1i} = 0 \text{ otherwise} \\
&\\
&V_{2i}^{*} = X_{2i}\beta_2 + \varepsilon_{2i} \\
&V_{2i} = 1 \text{ if } V_{2i}^{*} > 0,\ V_{2i} = 0 \text{ otherwise}
\end{aligned}
\tag{3.6}
$$

where β_1 and β_2 are vectors of unknown parameters to be estimated, and the disturbances $\varepsilon_{1i}, \varepsilon_{2i}$ are assumed to be bivariate standard normally distributed, with correlation coefficient ρ.

Three outcomes are possible: (i) individual *i* enrolls within the region of residence so that $V_{1i} = 1$ and $V_{2i} = 1$; (ii) individual *i* enrolls outside the region of residence so that $V_{1i} = 1$ and $V_{2i} = 0$; and (iii) individual *i* does not enroll so that $V_{1i} = 0$. This gives the following unconditional probabilities for the three outcomes:

$$
\begin{aligned}
&\Pr(V_{1i} = 1, V_{2i} = 1) = \Phi_2(X_{1i}\beta_1, X_{2i}\beta_2, \rho) \\
&\Pr(V_{1i} = 1, V_{2i} = 0) = \Phi_2(X_{1i}\beta_1, -X_{2i}\beta_2, -\rho) \\
&\Pr(V_{1i} = 0) = \Phi(-X_{1i}\beta_1)
\end{aligned}
\tag{3.7}
$$

where Φ_2 and Φ denote the bivariate standard normal cdf and the univarite standard normal cdf, respectively. Recognizing that V_{2i} is observed only if $V_{1i} = 1$, the log-likelihood function for this model can be formulated as:

$$
\begin{aligned}
\ln L = &\sum_{V_{1i}=1, V_{2i}=1} \ln \Phi_2(X_{1i}\beta_1, X_{2i}\beta_2, \rho) + \sum_{V_{1i}=1, V_{2i}=0} \ln \Phi_2(X_{1i}\beta_1, -X_{2i}\beta_2, -\rho) \\
&+ \sum_{V_{1i}=0} \ln \Phi(-X_{1i}\beta_1)
\end{aligned}
\tag{3.8}
$$

The parameters β_1 and β_2 together with the correlation coefficient ρ are estimated by maximizing $\ln L$. The joint estimation procedure has two substantive advantages. Firstly, even though the first probit equation in (3.6) can be estimated separately, as it is completely observed, the joint estimation will be more efficient if $\rho \neq 0$. Secondly, in the case $\rho \neq 0$, the joint estimation corrects for potential sample selection bias in the second probit equation in (3.6) and, in so doing, provides consistent estimates of the underlying population parameters.

Accessibility and transaction costs

As mentioned in the introduction, this paper primarily focuses on whether accessibility to university education influences university enrollment decisions. Generally, accessibility measures the ease or cost with which an activity can be reach from a particular region or location. In the specific context of this paper, accessibility is assumed to influence the gross transaction costs, *TC*, of reaching a schooling investment opportunity with preferred characteristics. More formally, let the gross transaction costs of investing be a negative and presumably non-linear function of accessibility to university education in the region of residence, denoted by AC^p:

$$TC_i^{pj} = TC_i^{pj}(AC^p), \qquad TC' < 0 \text{ and } TC'' > 0 \tag{3.9a}$$

The literature provides many alternative definitions of accessibility.[10] In this particular setting, a simple measure of accessibility would be the travel distance between the region of residence and the nearest university, denoted d_{pj}:

$$AC^p = f(d_{pj}) \tag{3.9b}$$

A person has higher accessibility the closer he lives to the nearest university. This formulation assumes that the individual only values schooling investment opportunities at the most adjacent university. A more general measure would consider investment opportunities in all possible destination regions, including the region of residence. Following this approach, accessibility can be calculated as:

$$AC^p = \sum_{j=1}^{J} o^j e^{-\lambda d_{pj}} \tag{3.9c}$$

where o^j is the supply of schooling investment opportunities in region *j* and $e^{-\lambda d_{pj}}$ is an exponential distance deterrence function with an unknown parameter λ. A natural extension would be to consider also the demand or competition for available investment opportunities. Following this approach, the relative accessibility can be calculated as:

$$AC^p = \sum_{j=1}^{J} e^{-\lambda d_{pj}} \frac{o^j}{I^j} \tag{3.9d}$$

[10] For an overview of different accessibility measures, see for instance Song (1996).

where I^j is the total number of potential investors in region *j*, likewise calculated as:

$$I^j = \sum_{k=1}^{J} i^k e^{-\lambda d_{jk}} \tag{3.9e}$$

The term relative accessibility is used to underline that this formulation assumes that accessibility is influenced both by the supply of and the demand for schooling investment opportunities. All of the above measures of accessibility will be considered in the empirical section. A few modifications will also be made, primarily concerning the exact formulation of the distance deterrence functions.

4. Data

The analysis is based on a longitudinal micro database that has been created by matching a number of administrative registers at Statistics Sweden (SCB) and the Swedish Labor Market Board (AMS). The database contains information on all Swedish inhabitants aged 16 to 64 and covers the period 1990 to 1996. The quality of the data is generally very high with relatively few administrative errors and missing values.[11] For this particular study, approximately 835,000 individuals have been sampled from the database. The sampling has been done in several steps. Firstly, all individuals aged 19 to 29 at the end of 1996 were sampled. This age group consists of approximately 1.3 million individuals and includes about 90 percent of all university entrants in any given year. Secondly, persons in this age group who already had a university degree or were currently or previously enrolled as university students were excluded from the data set. The exclusion of people who are already attending or have attended university allows us to focus on university entrants in a true sense. The remaining 835,000 individuals constitute the population at risk of investing in university education.

Since the investment decision is modeled in a bivariate setting, there are two outcome variables to pay attention to. The outcome variable for the decision whether or not to invest is coded as one, if the individual is registered as a university entrant in the autumn semester of 1996, and zero otherwise.[12] The outcome variable for the choice whether to invest within or outside the region of residence is coded as one, if the

[11] The administrative register from AMS is an exception. To guarantee internal consistency and quality, the variables in this register have been checked and reconstructed for this study.

[12] No distinction is made between those who enroll in a single-subject course and those who enroll in a full study program. As both paths might very well lead to the same result in terms of degrees and so on, there is no obvious reason to restrict the analysis to either one.

individual is registered as a university entrant in the autumn semester of 1996 and has not changed his region of residence between the end of 1995 and the end of 1996, and zero otherwise.[13] Region here refers to the 24 counties that existed in 1996. As there is at least one university or university college located in each county, every individual, regardless of his region of residence, has the opportunity to apply to a university in his home region.

Following the analytical framework, the independent variables assumed to affect the investment decision are classified into four groups. If not otherwise noted, the independent variables refer to the situation in 1996.

The first group of variables is intended to describe various regional attributes. Accessibility to university education (*ACCESS*), defined according to equations (3.9d) and (3.9e), is included as an indicator of the gross transaction costs of investing in schooling. In order to capture intra-county differences in accessibility that depend on the exact location of residences and universities, this measure has been calculated on the basis of the 286 municipalities existing in 1996.[14] Two measures of regional labor market conditions are included. Expected annual labor earnings for upper-secondary school graduates are used as a measure of the opportunity cost of attending university (*OPPCOST*), calculated as $Y_h(1-u_h)$, where Y_h is the average regional annual labor earnings in 1,000 SEK of full-time employed upper-secondary school graduates and u_h is the average regional unemployment rate among upper-secondary school graduates.[15] The ratio of expected annual labor earnings for university graduates to expected annual labor earnings for upper-secondary school graduates is used as an indicator of the expected return to university education (*RETURN*), defined as $Y_c(1-u_c)/Y_h(1-u_h)$, where Y_c is the average regional annual labor earnings in 1,000 SEK of full-time employed university graduates and u_c is the average regional unemployment rate among university graduates.[16] Both measures have been calculated on the basis of the

[13] To establish that those coded as zero actually have migrated to another region due to university education, the regional destination of the move has been compared with the geographical location of the university of enrollment and the timing of the move has been compared with the start of the autumn semester.

[14] The following information has been used in the calculation of the accessibility measure. The supply of schooling investment opportunities, defined as o^j in equation (3.9d), is represented by the number of enrolled students at universities located in the municipality (only the ones with at least 200 enrolled students have been considered). The number of potential investors, defined as i^k in equation (3.9e), is represented by the population at risk (i.e. the number of individuals aged 19 to 29 not currently or previously enrolled) in the municipality. The travel distance, defined as d_{pj} in equation (3.9d), is the shortest road travel distance between any two pairs of municipalities, and has been calculated on the basis of data from the Swedish Road Administration (Vägverket).

[15] A person is defined as full-time employed if he is coded as employed in the *ÅRSYS/RAMS*-register and has not received any unemployment benefits, childcare allowances or pensions during the year.

[16] Definition of full-time employed as in the previous note.

106 local labor market areas that existed in 1996. Finally, the log of the number of registered students at the university/universities in the county of residence is included as a proxy for the quality and quantity of schooling and consumption opportunities (*CONSUMP*).

The second group of variables is intended to reflect the individual's family background characteristics. The sum of parental annual labor earnings (*EARNINGS*) in 1,000 SEK is included as a measure of financing opportunities.[17] Information on the highest educational level achieved by either of the parents is also included: pre-secondary school (*PRESEC*), upper-secondary school (*UPPSEC*), short post-secondary school (*POSTSECS*), long post-secondary school (*POSTSECL*), and post-graduate education (*POSTGRAD*). Besides reflecting differences in ability uncertainty related to family background, these variables also serve as indicators of family wealth and schooling aptitude passed on by the parents.

The third group of variables is intended to describe attributes of the individual. It includes information on educational attainment in terms of completed nine years of compulsory school (*COMPULS*)[18] and four different fields of study in upper-secondary school: natural science (*UPPNAT*), technology (*UPPTECH*), social science, humanities and arts (*UPPSOC*), and the aggregate of all other study fields (*UPPOTH*). In the absence of information such as test scores and school grades, these variables are used as indicators of unobserved individual ability. This is obviously rather crude proxies for individual ability. There is, nevertheless, a fairly clear correspondence between test scores, school grades and completed field of study.[19] Three variables are included to reflect individual differences in the opportunity cost of attending university. These are the number of days registered as unemployed (*UNEMP*), the number of days registered as unemployed squared/1000 (*UNEMPSQ*), and an indicator of being outside the labor

[17] This variable is defined as the average of the sum of parental annual labor earnings during the period 1990 to 1996, expressed in 1,000 SEK and 1996 years' prices. By focusing on the average of earnings over a number of years, potential problems with short-term fluctuations can be avoided and hopefully a measure of permanent earnings more closely linked to family wealth than any alternative one-period measure can be obtained.

[18] For 17 percent of the sample, the highest education level achieved is nine years of compulsory school. Even though lacking a complete upper-secondary education, individuals in this group may still meet the formal admission requirements for attending university. They may for instance have received general eligibility through the higher education aptitude test or through qualifications from foreign upper-secondary schools, which are not reported in the Swedish official statistical system. The descriptive statistics below also show that 3 percent of the university entrants indeed have compulsory school as highest educational level achieved (see Table 4.1).

[19] For upper-secondary school graduates of 1994/95, the following average school grades in mathematics, English and Swedish according to a five-point number scale (1−5) were reported: *UPPNAT* (3.72, 3.86, 3.78); *UPPTECH* (3.40, 3.27, 3.25); *UPPSOC* (3.15, 3.28, 3.36); *UPPOTH* (3.08, 3.09, 2.96). Source: National Agency for Education (1996). Those who only have completed compulsory school are presumably the ones that have been the least successful in terms of test scores and school grades.

Table 4.1 Sample means for independent variables

	Whole sample	Enrollment observed ($V_{1i}=1$)	Enrollment within the region of residence observed ($V_{1i}=1$, $V_{2i}=1$)
REGIONAL ATTRIBUTES			
ACCESS	0.36	0.44	0.49
OPPCOST	166.17	166.08	166.81
RETURN	1.58	1.58	1.58
CONSUMP	2.71	2.71	2.82
FAMILY BACKGROUND			
PRESEC	0.21	0.078	0.079
UPPSEC	0.53	0.37	0.38
POSTSECS	0.14	0.21	0.20
POSTSECL	0.11	0.31	0.31
POSTGRAD	0.0072	0.031	0.034
EARNINGS	297.16	382.68	383.70
INDIVIDUAL ATTRIBUTES			
COMPULS	0.17	0.030	0.031
UPPNAT	0.024	0.19	0.18
UPPTECH	0.051	0.16	0.15
UPPSOC	0.17	0.41	0.42
UPPOTH	0.58	0.21	0.22
UNEMP	39.66	29.86	30.34
UNEMPSQ	6.28	3.55	3.65
OUTLF	0.11	0.20	0.20
AGE	23.83	21.30	21.39
FEMALE	0.46	0.54	0.54
BORNSWE	0.95	0.95	0.96
HOUSEHOLD STATUS			
SINGLE	0.79	0.96	0.95
MARRIED	0.017	0.0065	0.0077
MARRCHI	0.16	0.026	0.032
SINGCHI	0.030	0.0073	0.0088
Number of observations	835,555	36,380	27,433

force (*OUTLF*).[20] Finally, the individual's age (*AGE*), sex (*FEMALE*), and a dummy variable for being born in Sweden (*BORNSWE*) are included.

The fourth group of variables is intended to reflect household related differences in the net transaction costs of investing and includes information on the following family types: single without children (*SINGLE*), married without children (*MARRIED*), married with children (*MARRCHI*), and single with children (*SINGCHI*). Sample means for all the independent variables are presented in Table 4.1.

[20] A person is classified as being outside the labor force if he has not been registered as unemployed during the year and has received less than 10,000 SEK in labor earnings during the year.

5. Empirical results

The maximum likelihood estimates of the parameters together with their *t*-statistics are shown in Table 5.1. Beginning with the regional attributes, we see that the probability of enrollment increases with accessibility to university education (*ACCESS*). The estimates also show that accessibility adds to the likelihood of enrollment within the region of residence, or, in other words, accessibility deters schooling induced out-migration. Continuing with the regional labor market variables, we find that the probability of enrollment decreases with the opportunity cost of attending university (*OPPCOST*) and with the expected return to university education (*RETURN*). While the negative effect from an increase in the opportunity cost is expected, the negative effect from an increase in the expected return is not. The estimates also indicate a positive effect of both variables on the probability of enrollment within the region of residence. A possible explanation of the somewhat ambiguous effect of the regional labor market variables might be that people tend to respond to the general labor market situation in the regions rather than to the labor market conditions for one education group in relation to another. Such behavior would, perhaps, also seem more reasonable in terms of the information requirements on the part of the investors. This interpretation has support in alternative specifications.[21] Finally, we see that the likelihood of enrollment unexpectedly decreases with the proxy for the quality and quantity of schooling and consumption opportunities (*CONSUMP*), whereas this variable, as expected, increases the probability of enrollment within the region of residence. A possible explanation for the former result might be that people living in large university regions are faced with many competing opportunities when deciding whether or not to invest in higher education.

Continuing with the family background characteristics, the estimates reveal that the probability of enrollment increases the higher the level of parental education. People having parents with upper-secondary education or higher (*UPPSEC*, *POSTSECS*, *POSTSECL*, *POSTGRAD*) are more likely to attend university than persons in the excluded group with pre-secondary educated parents (*PRESEC*). We also find that the probability of enrollment increases with parental earnings (*EARNINGS*). None of the

[21] For instance, replacing (*OPPCOST*) and (*RETURN*) with the expected annual labor earnings for full-time employed workers aged 16−64, defined as $Y_{16-64}(1-u_{16-64})$, gives the following parameter estimates and *t*-statistics: equation (1) −0.002473, −9.20; equation (2) 0.004899, 3.99. According to this more general formulation of the regional labor market situation, expected annual labor earnings have a negative and significant effect on the probability of enrollment, but a positive and significant effect on the likelihood of enrollment within the region of residence.

Table 5.1 Estimates of the bivariate probit model with sample selection

	(1) Enrollment observed ($V_{1i}=1$)		(2) Enrollment within the region of residence observed ($V_{1i}=1$, $V_{2i}=1$)	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
REGIONAL ATTRIBUTES				
ACCESS	0.1011	18.06	0.2950	11.13
OPPCOST	−0.002446	−7.40	0.004389	3.36
RETURN	−0.3790	−7.88	0.3182	1.74
CONSUMP	−0.04490	−13.60	0.1681	7.41
FAMILY BACKGROUND				
UPPSEC	0.09434	9.91	−0.03935	−0.86
POSTSECS	0.2665	24.41	−0.07297	−0.73
POSTSECL	0.4151	36.98	−0.04622	−0.32
POSTGRAD	0.5051	21.43	−0.0004567	−0.00
EARNINGS	0.0002425	13.72	−0.00004453	−0.49
INDIVIDUAL ATTRIBUTES				
COMPULS	−0.3680	−30.54	−0.09399	−0.69
UPPNAT	1.3340	116.86	−0.0009299	−0.00
UPPTECH	1.0048	99.29	−0.003421	−0.01
UPPSOC	0.6424	90.39	0.05639	0.25
UNEMP	0.002028	17.32	0.0002783	0.36
UNEMPSQ	−0.01109	−19.99	0.0001487	0.04
OUTLF	0.1782	20.24	0.0002069	0.00
AGE	−0.07685	−66.50	−0.003601	−0.14
FEMALE	0.1936	32.13	0.03964	0.62
BORNSWE	0.05050	3.73	0.1594	4.32
HOUSEHOLD STATUS				
MARRIED	−0.1769	−6.60	0.4553	3.45
MARRCHI	−0.3130	−23.34	0.8347	4.98
SINGCHI	−0.08999	−3.67	0.6758	5.31
CONSTANT	0.3860	3.95	−1.3763	−4.94
ρ			0.1155	0.29
Log *L*	−134,221			
Number of observations	835,555			

family background variables have any significant effect on the likelihood of enrollment within the region of residence.

Turning to the individual characteristics, the estimates show that the probability of enrollment increases with ability, as measured by compulsory school and upper-secondary educational attainment. People with nine years of compulsory school (*COMPULS*) are less likely to attend university than persons in the excluded group with other upper-secondary education (*UPPOTH*), whereas people with upper-secondary education in natural science (*UPPNAT*), technology (*UPPTECH*), and social sciences

(*UPPSOC*) are more likely to enroll. The estimates of the variables reflecting individual differences in the opportunity cost of attending university further indicate that being outside the labor force (*OUTLF*) or unemployed (*UNEMP*) add to the probability of enrollment. As expected, we also find that the probability of enrollment decreases with the age (*AGE*) of the investor. Finally, we see that females (*FEMALE*) and those who are born in Sweden (*BORNSWE*) are more likely to attend university. The only significant effect on the probability of enrollment within the region of residence is the positive effect of being born in Sweden.

Continuing with the household characteristics, the estimates reveal that family ties have a significant and negative effect on the probability of enrollment, but increase the likelihood of enrollment within the region of residence. Both single and married persons with children (*SINGCHI*, *MARRCHI*) as well as married persons without children (*MARRIED*), are less likely to attend university than the excluded group of single persons without children (*SINGLE*). The opposite holds for the probability of enrollment within the region of residence.

Finally, the estimate of ρ is positive and insignificant, indicating that the null hypothesis of no correlation between unobserved attributes in the two equations cannot be rejected.

So far, we have focused on the estimated parameters. The marginal effects, evaluated at the means of the independent variables, are presented in Table 5.2. Note that there are two types of marginal effects. The marginal effects on the probability of enrollment are unconditional, whereas the marginal effects on the probability of enrollment within the region of residence are conditional on enrollment.[22]

A marginal increase in accessibility to university education (*ACCESS*) raises the probability of enrollment by about 0.005 and the probability of enrollment within the region of residence by 0.08. The estimates indicate relatively large differences in the likelihood of enrollment depending on compulsory school and upper-secondary educational attainment. The probability of enrollment for people with upper-secondary education in social sciences (*UPPSOC*), technology (*UPPTECH*), and natural science (*UPPNAT*) is roughly 0.03 to 0.06 higher than the probability for the excluded group of persons with other upper-secondary education (*UPPOTH*). The findings also reveal rather substantial differences in the likelihood of enrollment within the region of residence depending on household status. The probability of enrollment in the home region for persons with a spouse and/or children (*MARRIED*, *MARRCHI*, *SINGCHI*) is

[22] The marginal effects on the first probability can generally be expressed as $\partial E[V_1 | X]/\partial X$, and the marginal effects on the second probability as $\partial E[V_2 | V_1 = 1, X]/\partial X$.

Table 5.2 Estimates of the marginal effects on the probability of enrollment and the probability of enrollment within the region of residence

	(1) Enrollment observed ($V_{1i}=1$)		(2) Enrollment within the region of residence observed ($V_{1i}=1$, $V_{2i}=1$)	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
REGIONAL ATTRIBUTES				
ACCESS	0.004622	18.03	0.08150	3.58
OPPCOST	−0.0001118	−7.41	0.001329	3.26
RETURN	−0.01734	−8.10	0.1023	2.46
CONSUMP	−0.002056	−13.77	0.04946	3.91
FAMILY BACKGROUND				
UPPSEC	0.004314	9.97	−0.01406	−1.56
POSTSECS	0.01219	24.54	−0.02877	−2.67
POSTSECL	0.01898	36.84	−0.02550	−2.67
POSTGRAD	0.02310	21.23	−0.01505	−0.94
EARNINGS	0.00001108	13.97	−0.00001992	−1.53
INDIVIDUAL ATTRIBUTES				
COMPULS	−0.01682	−29.96	−0.01604	−1.12
UPPNAT	0.06099	92.53	−0.03968	−5.03
UPPTECH	0.04594	90.16	−0.03067	−3.99
UPPSOC	0.02937	82.89	−0.002833	−0.46
UNEMP	0.00009272	15.77	0.00001976	0.20
UNEMPSQ	−0.0005071	−16.99	0.0003703	0.72
OUTLF	0.008148	20.59	−0.005207	−0.88
AGE	−0.003513	−67.00	0.001240	1.17
FEMALE	0.008858	32.16	0.005630	0.99
BORNSWE	0.002307	3.74	0.04416	2.76
HOUSEHOLD STATUS				
MARRIED	−0.008086	−6.24	0.1356	2.95
MARRCHI	−0.01431	−23.23	0.2483	3.56
SINGCHI	−0.004120	−3.57	0.1962	3.22

about 0.14 to 0.25 higher than the probability for the excluded group of single persons without children (*SINGLE*).

Since this paper explicitly focuses on the role of accessibility to university education, it may be useful to express the effect of changes in this variable in a more straightforward way. Consider the mean percentage effect on the probability of enrollment of a one percent increase in each individual's accessibility, assuming that none of the other independent variables is changed. This effect can be calculated in the following way: $\text{mean}\{[\Phi(X_{i*}\hat{\beta})-\Phi(X_i\hat{\beta})]/\Phi(X_i\hat{\beta})\}$, where X_{i*} denotes the independent variable vector with accessibility increased by one percent, and X_i denotes the original independent variable vector. According to these calculations, a one percent

increase in accessibility to university education raises the probability of enrollment by 0.07 percent.

Alternative specifications of accessibility

The estimates presented above clearly indicate that a significant and expected relationship exists between accessibility to university education and the choice whether or not to invest in higher education and the interrelated decision whether to invest at a university within or outside the region of residence. Considering that previous Swedish studies report rather ambiguous effects of accessibility on enrollment decisions (see Section 2), it might be interesting to investigate whether the findings shown above are sensitive with regard to the exact specification of the accessibility measure.

Table 5.3 presents estimated parameters and *t*-statistics for five alternative accessibility formulations. Save for the different specifications of accessibility, the econometric model is set up exactly as in Table 5.1 and includes an identical set of right hand side variables.[23] The first three measures follow directly from the discussion in Section 3. The last two specifications include slightly modified distance deterrence functions. Note that the third formulation is identical to the one presented in Table 5.1. For the parameterized measures, a scan over different values of the distance deterrence parameter λ has been performed and the chosen value of λ is the one that maximizes the value of the log-likelihood function.

The results in Table 5.3 suggest that the effect of accessibility is quite robust with regard to the exact specification of the accessibility measure. All estimates are significant and have the expected signs. Based on the values of the log-likelihood functions, the relative accessibility formulations (3) and (5) appear to perform better than the other specifications.

Accessibility and social recruitment into higher education

This section concludes with an analysis of whether people with different abilities and family background differ in their sensitivity to accessibility to higher education. As already mentioned in the introduction, one of the motives behind the decision to

[23] As the results for the other variables are virtually identical to the ones reported in Table 5.1, they are omitted from the presentation.

Table 5.3 Estimates of the bivariate probit model with sample selection and alternative specifications of accessibility

	(1) Enrollment observed ($V_{1i}=1$)		(2) Enrollment within the region of residence observed ($V_{1i}=1, V_{2i}=1$)			
	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Log *L*	λ
(1) $AC^p = f(d_{pj})$	−0.0009709	−13.86	−0.002306	−7.73	−134,408	
(2) $AC^p = \sum_{j=1}^{J} o^j e^{-\lambda d_{pj}}$	0.0006154	3.02	0.006980	11.95	−134,494	0.20
(3) $AC^p = \sum_{j=1}^{J} e^{-\lambda d_{pj}} \frac{o^j}{I^j}, I^j = \sum_{k=1}^{J} i^k e^{-\lambda d_{jk}}$	0.1011	18.06	0.2950	11.13	−134,221	0.09
(4) $AC^p = \sum_{j=1}^{J} o^j d_{pj}^{-\lambda}$	0.0005224	3.21	0.005325	11.37	−134,500	2.00
(5) $AC^p = \sum_{j=1}^{J} d_{pj}^{-\lambda} \frac{o^j}{I^j}, I^j = \sum_{k=1}^{J} i^k d_{jk}^{-\lambda}$	0.07249	16.20	0.2044	10.31	−134,301	1.20

decentralize higher education in Sweden was to attract students from the lower social classes, and thereby reduce the uneven social recruitment into higher education. The decentralization policy was, in part, founded on the idea that the enrollment decisions of people with a less privileged background are more sensitive to accessibility to university education than those of persons from a more favorable background. However, as we already have seen, previous Swedish studies have found no evidence that any such differences in sensitivity to accessibility actually exist (see Section 2).

The analysis is restricted to the enrollment decision and is based on the estimation of three single equation probit models that include interaction terms of accessibility and ability, and accessibility and family background characteristics. Save for the interaction terms, the models are identical with the enrollment equation in column (1) in Table 5.1 and include an identical set of right hand side variables. The maximum likelihood estimates of the parameters together with their *t*-statistics are shown in Table 5.4.[24]

The specification in column (1) gives the result of interaction between accessibility and ability, as measured by compulsory school and upper-secondary educational attainment. The estimates indicate that people with upper-secondary education in natural science (*UPPNAT*), technology (*UPPTECH)*, and social sciences (*UPPSOC*) are significantly less sensitive to accessibility to university education than persons in the

[24] As the results for the other variables are almost identical to the ones given in column (1) in Table 5.1, the presentation is restricted to the interaction terms.

Table 5.4 Estimates of single equation probit models for the enrollment decision ($V_{1i} = 1$) including interaction terms

	(1)		(2)		(3)	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
*ACCESS*COMPULS*	−0.003304	−0.16				
*ACCESS*UPPNAT*	−0.06238	−3.26				
*ACCESS*UPPTECH*	−0.1085	−6.09				
*ACCESS*UPPSOC*	−0.05678	−4.75				
*ACCESS*UPPSEC*			−0.02084	−1.12		
*ACCESS*POSTSECS*			−0.04080	−1.99		
*ACCESS*POSTSECL*			−0.04297	−2.20		
*ACCESS*POSTGRAD*			−0.05505	−1.78		
*ACCESS*EARNINGS*					−0.0001298	−4.60

excluded group with other upper-secondary education (*UPPOTH*). The specification in column (2) tests for evidence of interaction between accessibility and parental education. Although barely significant, the estimates appear to suggest that individuals whose parents have post-secondary education or higher (*POSTSECS*, *POSTSECL*, *POSTGRAD*) are less sensitive to accessibility to higher education than the excluded group with pre-secondary educated parents (*PRESEC*). The specification in column (3) focuses on interaction between accessibility and parental earnings. The estimate reveals that the effect of accessibility to university education decreases significantly with parental earnings (*EARNINGS*).

In all, the results seem to indicate that the enrollment decisions of individuals with a less privileged background are more sensitive to accessibility to university education than those of persons from a more advantageous background. At least as long as background is measured in terms of ability, parental education, and parental earnings.

6. Summary and concluding remarks

The purpose of this study has been to examine how accessibility to higher education affects university enrollment decisions in Sweden. The empirical analysis refers to the autumn semester of 1996 and is based on a large administrative data set covering approximately 835,000 individuals aged 19−29. Potential problems with sample selection bias are taken into consideration in the econometric specification by using a bivariate probit model with sample selection. The first equation focuses on the individual's choice whether or not to invest in a university education, the second on the

interrelated decision whether to invest at a university within or outside the region of residence. The empirical findings show that the probability of enrollment increases with accessibility to university education. The results also indicate that accessibility adds to the likelihood of enrollment within the region of residence, or, in other words, accessibility deters schooling induced out-migration. Neither of these findings is sensitive with regard to the exact specification of accessibility. Moreover, the empirical results reveal that the enrollment decisions of individuals with a less privileged background are more sensitive to accessibility to university education than those of persons from a more favorable background. The influence of accessibility on enrollment decreases significantly with individual ability, parental education, and parental earnings.

During the last 15 years, Sweden has experienced a very substantial expansion and geographical decentralization of higher education. The number of university entrants and enrolled students has increased steadily, particularly so at newly established universities and university colleges. Given the empirical findings in this study, it appears as if the decentralization policy has the potential to be successful in its regional ambitions. Through their effect on accessibility and enrollment rates, the establishment and expansion of new universities have the potential to generate a growing regional accumulation of human capital outside the metropolitan areas. Whether the regional impacts of such a development will be of a short-term or long-term nature depends, however, on the regions' ability to hold on to and attract university educated labor. In the event that the new university regions will only play the role of exporters of human capital, the regional economic consequences are likely to be rather limited. The empirical results in this paper further indicate that a continued geographical decentralization of university education has the potential to contribute to a more even social recruitment into higher education.

There are still only a few available papers using Swedish data to analyze investments in higher education from a regional perspective. One important topic for future research is to study what happens after graduation. Do students find jobs and continue to live in the university regions after graduation, or do they move on to look for work elsewhere? Do the economic returns to higher education differ depending on from which university or university college students graduate from? Such questions are interesting both from a societal perspective and from the point of view of individuals about to invest in higher education.

References

Becker, G. (1964), *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, The University of Chicago Press, Chicago.

Becker, G. (1967), *Human Capital and the Personal Distribution of Income: An Analytical Approach*, The University of Michigan Press, Ann Arbor.

Betts, J. and McFarland, L. (1995), Safe Port in a Storm: The Impact of Labor Market Conditions on Community College Enrollments, *Journal of Human Resources 30* (4), 741−765.

Dryler, H. (1998), Educational Choice in Sweden: Studies on the Importance of Gender and Social Contexts, Ph.D. Thesis no. 31, Swedish Institute for Social Research, Stockholm University.

Graves, P. and Linneman, P. (1979), Household Migration: Theoretical and Empirical Results, *Journal of Urban Economics 6* (3), 383−404.

Greene, W. (1998), *LIMDEP, Version 7.0: User's Manual*, Econometric Software, New York.

Greene, W. (2000), *Econometric Analysis*, 4th ed., Prentice Hall, New Jersey.

Grubb, W. (1988), Vocationalizing Higher Education: The Causes of Enrollment and Completion in Public Two-Year Colleges, 1970−1980, *Economics of Education Review 7* (3), 301−319.

Grubb, W. (1989), The Effects of Differentiation on Educational Attainment: The Case of Community Colleges, *Review of Higher Education 12* (4), 349−374.

Hartog, J. (1983), To Graduate or Not: Does it Matter?, *Economic Letters 12* (2), 193−199.

Heckman, J. (1979), Sample Selection Bias as a Specification Error, *Econometrica 47* (1), 153−161.

Kane, T. (1995), Rising Public College Tuition and College Entry: How Well Do Public Subsidies Promote Access to College?, NBER Working Paper Series no. 5164, National Bureau of Economic Research, Cambridge.

Kjellström, C. and Regnér, H. (1999), Does Distance to a University Affect Enrollment Decisions? Evidence from Data on Three Cohorts of Swedes, in C. Kjellström, Essays on Investment in Human Capital, Ph.D. Thesis no. 36, Swedish Institute for Social Research, Stockholm University.

Levhari, D. and Weiss, Y. (1974), The Effect of Risk on the Investment in Human Capital, *American Economic Review 64* (6), 950−963.

Manski, C. and Wise, D. (1983), *College Choice in America*, Harvard University Press, Cambridge Mass.

Meng, C-L. and Schmidt, P. (1985), On the Cost of Partial Observability in the Bivariate Probit Model, *International Economic Review 26* (1), 71−85.

Mincer, J. (1974), *Schooling, Experience, and Earnings*, National Bureau of Economic Research and Columbia University Press, New York.

Mincer, J. (1978), Family Migration Decisions, *Journal of Political Economy 86* (5), 749−773.

National Agency for Education (1996), Skolan i siffror (Facts about the Swedish Compulsory and Upper Secondary School), Rapport nr. 88, Stockholm.

Ordovensky, J. (1995), Effects of Institutional Attributes on Enrollment Choice: Implications for Postsecondary Vocational Education, *Economics of Education Review 14* (4), 335−350.

Psacharopoulos, G. (1994), Returns to Investment in Education: A Global Uppdate, *World Development 22* (9), 1325−1343.

Rouse, C. (1994), What to Do After High School: The Two-Year versus Four-Year College Enrollment Decision, in R. Ehrenberg (ed.), *Choices and Consequences: Contemporary Policy Issues in Education*, ILR Press, Cornell University, Ithaca NY.

Rouse, C. (1995), Democratization or Diversion? The Effect of Community Colleges on Educational Attainment, *Journal of Business & Economic Statistics 13* (2), 217−224.

Sjögren, A. (2000), Occupational Choice and Incentives: The Role of Family Background, IUI Working Paper no. 539, The Research Institute of Industrial Economics, Stockholm.

Song, S. (1996), Some Tests of Alternative Accessibility Measures: A Population Density Approach, *Land Economics 72* (4), 474−482.

Weiler, W. (1989), A Flexible Approach to Modeling Enrollment Choice Behavior, *Economics of Education Review 8* (3), 277−283.

Weiss, A. (1988), High School Graduation, Performance, and Wages, *Journal of Political Economy 96* (4), 785−820.

van de Ven, W. and van Praag, B. (1981), The Demand for Deductibles in Private Health Insurance: A Probit Model with Sample Selection, *Journal of Econometrics 17* (2), 229−252.

Venti, S. and Wise, D. (1983), Individual Attributes and Self-Selection of Higher Education: College Attendance versus College Completion, *Journal of Public Economics 21* (1), 1−32.

Öckert, B. and Regnér, H. (2000), Högre utbildning i Sverige. En problemorienterad diskussion om utbildningssatsningar (Higher Education in Sweden: A Discussion on Investments in Education), Swedish Institute for Social Research, Stockholm University.