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Does Distance Determine Who Attends a University in Germany?

SOEPpapers on Multidisciplinary Panel Data Research, No. 118

Provided in Cooperation with:
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Suggested Citation: Spieß, C. Katharina; Wrohlich, Katharina (2008) : Does Distance Determine Who Attends a University in Germany?, SOEPpapers on Multidisciplinary Panel Data Research, No. 118, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin

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SOEP The German Socio-Economic Panel Study

SOEPpapers

on Multidisciplinary Panel Data Research

118

C. Katharina Spiess • Katharina Wrohlich

Does distance determine who attends a university in Germany?

Berlin, July 2008

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ISSN: 1864-6689 (online)

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Does distance determine who attends a university in Germany?

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(July 2008)

Abstract: We analyze the role of distance from a university in the decision to attend higher education in Germany. Students who live near a university can avoid moving and the increased living expenses by commuting. Thus, transaction cost arguments would suggest that the greater the distance to the nearest university, the lower the participation in higher education. We analyse this hypothesis by combining data from the German Socio-Economic Panel Study (SOEP) with a database from the German Rectors' Conference on university postal codes. Based on a discrete time hazard rate model we show that distance to the next university at the time of completing high school significantly affects the decision to enrol in tertiary education. Controlling for many other socio-economic and regional variables, we find that 1 kilometre distance decreases the probability to enrol in higher education by 0.2 – 0.3 percentage points.

JEL classification: I2, R1

Key words: Higher education, distance to university, competing risk model.

Acknowledgement: This paper profited substantially from the support of Tobia Lakes and Stefan Süss from the Geomatics Department at the Institute of Geography, Humboldt-University Berlin. Without their support in the calculations of distances from homes to universities, this paper would not exist. We also thank Elisabeth Bügelmayer for helpful research assistance and Thomas Siedler and Viktor Steiner for valuable comments. Deborah A. Bowen and Nicole Scheremet provided helpful editorial assistance. Financial support from the German Science Foundation (DFG) under the project STE 681/6-2 is gratefully acknowledged.

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1 Introduction

While the effects of many different socio-economic background variables and financial incentives on educational attainment have been widely researched, we still know relatively little about whether and how regional factors affect educational decisions. This is surprising, as policy makers usually assume—either implicitly or explicitly—that the existence of an educational infrastructure and thus the accessibility to education are important determinants in a country's educational outcomes. The accessibility of education is influenced at least by two factors, (i) individual financial resources and (ii) distance. Thus, the closer learning opportunities are, the better the access to further education.

In this contribution we focus on the individual decision to attend higher education, and the role of distance to higher education institutions, namely universities. There is a large body of literature concerning the transition to higher education, or the rationale behind the decision to participate in higher education. Many studies focus on the relationship between participation in higher education and individual socio-economic backgrounds. Typical findings are that the education of the parents, in particular the father, and household income increase the probability of a transition into higher education (see, among others, Acemoglu and Pischke 2001 and Shea, 2000). Some studies on this relationship focus on special groups such as migrants (e.g., Gang and Zimmermann 2000), or conduct cross-country comparisons, (e.g., Lauer 2003).[1] Another strand of research deals with the role of economic incentives in determining the decision to attend higher education. This research focuses either on expected wages or other financial incentives such as student financial aid or tuition. For German studies in this context, see Lauer (2002a and b), Baumgartner and Steiner (2006), or Steiner and Wrohlich (2008). The results of the study by Lauer (2002) suggest that financial constraints limit participation in higher education and that the participation decision is affected by return expectations in terms of labour market outcomes and by financial incentives such as student aid. Also Steiner and Wrohlich (2008) find a small (although significant) positive effect of student financial aid on the enrolment decision in Germany.

Given the variety and extent of research on this subject, it is remarkable that regional aspects play a minor role, if any, in economic analyses of the transition to higher education[2]. This is particularly true of economic analyses in Germany. In the sociology of education, in contrast,

there is a broad and long-lasting debate as to whether regional differences—in particular between rural and urban areas—play a role in explaining educational outcomes (for a current summary of the sociological literature on region and education, see for instance Sixt 2007). Regional differences in this context are mainly measured by rural-urban dummy variables or population size variables. Such measures are used in Anglo-American studies by economists as well, who focus on the role of regional differences as a determinant of the choice to enrol in higher education (for instance, Kane and Spizmann 1994 or Christofides et al. 2001). Implicitly, these studies assume that rural areas are disadvantaged in the sense that institutions offering higher education, such as universities or colleges, are more difficult to reach, and thus less likely to be attended by individuals in rural areas or small towns. It is implicitly assumed that residents of urban areas are closer to universities or colleges than rural residents. However, this is not necessarily the case, as some universities and colleges are easily accessible to nearby rural residents. Conversely, some mid-sized urban areas do not have any institutions of higher education at all. To our knowledge, there exist only a few nationwide representative Anglo-American studies that explicitly focus on the exact distance to higher education institutions.[3]

Card (1995) uses a variable indicating the presence of a four-year college in one's local labour market during childhood as an instrument in estimating the returns to schooling in future years. To justify the use of college proximity as an instrument in studying the returns to schooling, Card shows that students who grew up in an area with a four-year college nearby ended up with about one more year of schooling on average. Based on nationwide representative household survey data for Canada and a database of university postal codes, Frenette (2004 and 2006) analyses the relationship between distance to school and university participation. He shows that students whose place of residence is farther away are less likely to attend university, and that students from lower-income families are particularly disadvantaged by distance (Frenette 2006). Although there is a negative relationship between distance and participation in higher education for the distance to universities and colleges, this relationship is stronger for the distance to the nearest university (Frenette 2004). One of the few European studies that analyze the distance to the next university is the work by Denzler and Wolter (2008). Based on a Swiss data set, they explain the decision to become a teacher, which is linked to the decision to attend a specialized college of education and not a university offering a broad range of majors. Their estimation results show that the longer the distance to the next university, measured as the time needed to commute between an

individual's home town and the next university, the higher the probability of attending a college of education and not a university.

Apart from this, some economic studies use the distance to university as an exogenous variable in estimations of the decision for a particular university. Based on the US "High School and Beyond" dataset, Chau (2004) measures the effects of living near a "high-quality" college on the choice of college attended. He focuses on—what he calls—potential "spillover effects" of local universities, which he argues can have a defining effect on the surrounding community. He finds that the presence of a first-tier public university increases the quality of the college attended for low-income individuals by about 0.27 standard deviations. In the German context, Fabel et al. (2002), for instance, show that the distance to a university with economics as a field of study has a significant effect on the decision to study economics there. For Germany, similar results have also been found for student decisions to attend a particular university. In a descriptive analysis, Krawietz and Heine (2007) show that the proximity of a particular university to an individual's hometown is one of the most important factors explaining the decision to attend that university. However, this decision is not the one at the focus of the present paper: we are interested in the preceding decision, namely, the decision to study at all.

From an economic point of view, the relationship between distance to a university and participation in higher education can be explained with the "transaction cost argument". The larger the distance to a university, the higher the transaction costs of higher education. There might be direct financial costs, if students have to leave their parents' home or if they have to commute. There are search costs for a new place to live, moving costs, rental costs, costs of purchasing new furniture or other items for a new apartment. Furthermore there are indirect financial costs, such as forgone economies of scale associated with sharing the household within the family. There may also be emotional costs associated with leaving home. Some students might be reluctant to leave home because of their network of family and friends. Even if they do leave home, they might want to visit their family and friends on a regular basis, which is linked to higher commuting costs with greater distance.[4] Apart from this classic explanation, there might be other costs related to distance. One might argue that students who live in or very close to a university town have lower information costs when seeking information on the decision to participate in higher education.

However, the explanation for the distance effect might lie not only in this transaction cost argument. The effect might be driven by something similar to a "neighbourhood effect"[5]. Chau (2004) argues that the presence of a local university can generate "neighbourhood effects" or "spillover effects" that affect the behaviour and outcomes of the residents of that neighbourhood. Surrounded by a university environment, youths may grow up looking at university education as a natural goal. Apart from this "peer group effect," a "neighbourhood effect" might be explained by an "information network effect" (Chau 2004: 256): a university´s student body and academic resources offer individuals information about university life that can influence their decisions. Thus, in principle, a distance effect might be explained by the "transaction cost argument" or a potential "neighbourhood effect". As described below, we try to separate these two effects.[6]

2 Empirical Framework

In order to estimate the effect of the distance to university on enrolment in higher education, we specify a discrete choice model with the distance to university at the time of obtaining university entrance exam as an explanatory variable. After high school, we observe individuals choosing different paths: some decide on employment without any further education; others choose vocational training; and the majority decide to enrol in higher education. Since many of these transitions, in particular the transition to university, are not observed immediately after leaving high school, we track individuals five years after completion of high school and estimate a discrete time hazard rate model in order to account for right-censored spells. We use a five-year period, first, since many men choose to start military or civil service before going to the university, and second, since a significant percentage of individuals who have passed their university entrance exams choose to complete some kind of vocational training first. Given this data structure, we end up with a discrete time hazard rate model with three independent competing risks, namely the transition to employment (A), to vocational training (B), or to university education (C).[7]

The destination-specific hazard rate, $h_{ij}(t_i \mid x_{it})$, i.e., a potential student's conditional probability of making a transition into state j (j = A, B, C) in period t, given that no transition has occurred until the beginning of that period, is specified by a multinomial logit:

$$(1) \quad h_{ij}(t_i \mid x_{it}) = \frac{\exp\left(\beta'_j x_{it}\right)}{1 + \sum_{j=1}^{3} \exp\left(\beta'_j x_{it}\right)}$$

The vector x_{it} contains the explanatory variables. In our context, the main variable we are interested in is the distance to the next university at the time of completing high school. (See next section for more information on this variable). However, x_{it} also includes many other control variables. Besides socio-economic background variables such as parental education, parental income, parental family status and number of siblings, we include several other regional characteristics. First of all, we include dummy variables for different German states. Second, we include dummy variables indicating three different categories of population density in the hometown, which allows us to control for potentially different behaviour of "urban" and "rural" citizens that are not driven by the mere distance to the next university. In addition, we also include a dummy variable indicating whether an individual has grown up in a university town, which we interact with the student population density in that town. Controlling for this variable allows us to separate the transaction cost argument from peer or neighbourhood effects.

The survivor rate, $S(t)$, which gives the unconditional probability of not having enrolled in higher education or vocational training or having started employment up to period t, can be written (ignoring person and time indices) as

$$(2) \quad S(t \mid x) = \prod_{k=1}^{t-1} \left[1 - h\left(t \mid x\right)\right], \text{ with } h\left(t\right) = \sum_{j=1}^{3} h_j\left(t \mid x\right),$$

assuming that competing risks are independent. In terms of the hazard rate and the survivor function, the probability of a transition into state j in period t is given by

$$(3) \quad P_j\left(t \mid x\right) = h_j\left(t \mid x\right) \prod_{\tau=1}^{t-1} \left[1 - h\left(t \mid x\right)\right].$$

Assuming that, conditional on x, all observations are independent, the sample likelihood function is given by

$$(4) \quad L = \prod_{i=1}^{n} \left[h_{ij}\left(t_{ij} \mid x_{it}\right)\right]^{\delta_{ij}} \prod_{\tau=1}^{t_i - 1} \left[1 - h\left(t_i \mid x_{it}\right)\right]$$

$$\text{with } \delta_{ij} = \begin{cases} 1, & \text{if individual } i \text{ makes a transition into state } j \\ 0, & \text{otherwise.} \end{cases}$$

Hence, for a person with an observed transition in the observation period, the contribution to the likelihood function is given by the respective transition probability in equation (3), and for a censored spell, it is given by the survivor function in equation (2).

3 Data and descriptive results

3.1 Description of the data

The data used for this study come from the German Socio-Economic Panel (SOEP), a panel study that has been running for 25 years.[8] The SOEP is a representative sample of private households living in Germany that provides information on all household members above the age of 16. The sample underlying our analyses consists of individuals who reported that they had passed their university entry exams (Abitur) the year before or the year of the survey. This is the population at risk for a transition to higher education. This subsample covers 1,223 respondents from the 1993 to 2006 waves. We could not include earlier waves as no information on the zip code of the respondents' place of residence was available for these earlier years (see Knies and Spiess 2007). Furthermore, we drop all observations for which we cannot track the parents and thus lack information on parental income. This leaves us with a sample of 1,219 persons. Of these 1,219 persons with university entrance qualifications, the majority opt for further education: 653 (54%) choose to enrol in a university within a maximum of five years after having completed high school, and 380 (31%) choose vocational training. Sixty-seven (6%) transition into employment without further education and the remaining 119 (10%) observations are right-censored, i.e., we do not observe a transition into any of the three states during the observation period.

Table 1: Sample size and observed transitions

Transition to… observed after period …	Employment	Vocational training	University	Right censored cases	Total
1	57	332	471	94	954
2	8	39	127	16	190
3	1	8	30	6	45
4	0	1	10	2	13
5	1	0	15	1	17
Total	67	380	653	119	1,219

Source: SOEP waves 1993-2006, own calculations.

In order to obtain information on the precise distance to the next university at the time of the university-entrance degree, we match data from the German Rectors' Conference ("Hochschulrektorenkonrenz – HRK") containing the address of all universities in Germany to the individual data from the SOEP. The dataset of the German Rectors' Conference includes the address of all universities in Germany, including information on the type, sponsor, and year of opening (HRK 2007). In total, there are 347 universities in Germany. Two-hundred and thirty-three of them are public universities. Thirty-eight percent of these are universities in a stricter sense, 42% of them are universities of applied science ("Fachhochschulen"), and 20% are universities of the arts. There are 72 private universities, which are mainly universities of applied science (85%). Forty-two universities are church-based, 29% of them are universities in a stricter sense, and 50% are universities of applied science (HRK 2007). In this analysis, we concentrate solely on the distance to public universities (including universities of applied sciences). Furthermore, we exclude public universities of the arts. For all these universities, special rules apply to applications, and special tuition has to be paid. This might influence the decision for higher education as well, but in a different manner. Thus we argue that the distance to these universities is of minor importance for the overall decision to attend university or not. In addition, the proportion of private universities and universities of the arts is relatively small in comparison to the proportion of the public universities in Germany.

As is shown in the map in the Appendix, the places of residence of individuals with a university entrance exam are distributed across all of Germany. There are only a few regional clusters, which are related mainly to the higher population density around the major German cities: Berlin, the Cologne area, Hamburg, Frankfurt, Stuttgart, and Munich. The same is true for the locations of German universities, if all public universities are taken into account.

Based on these data sets and given our information on the respondent's zip code, we were able to calculate the distance to the nearest university for each respondent in our subsample. We calculated three different types of distance: (1) The distance to the closest public university, (2) the distance to the closest public university of applied science, (3) the lesser of the two. These distances were calculated as distance between the centres of gravity of two zip code polygons. Thus for each zip code, first of all, the centres of gravity had to be determined.[9] All distance calculations were done using the geographical information system ArcGIS.

To disentangle the "transaction cost" hypothesis from the "neighbourhood effect hypothesis" as potential explanations for the distance effect, we further added external information on the student population density in those university towns where respondents live as a proxy for a potential "neighbourhood effect". We assume that the student population density is a proxy for the described "peer-group effect" or "information effect" in university towns. The more students per resident, the more peers they have around them and the more options for information about a university education. Based on information from the Federal Office for Building and Regional Planning (BBR, various years) we could match the number of students per 1,000 citizens in each university town to the individual SOEP data on the county level.[10]

3.2 Descriptive Statistics

Table 2 shows descriptive statistics on the explanatory variables. The average distance to university is 22 km for the observations in our sample (median: 17 km), and the average distance to the nearest university of applied sciences is 21 km (median: 17 km). The minimum distance to a university (or university of applied science) in our sample is found for residents living in the same zip code district (0 km), while the maximum distance is 95 km to the next university and 86 km to the next university of applied sciences.

About half of the sample consists of males, and almost three quarters of all observations hold the Abitur. This university entrance exam qualifies holders to attend a university, in contrast to the "Fachhochschulreife," which qualifies holders to attend a university of applied sciences. Another important variable in our analysis is the student population density, for which we find an average of 18 students per 1000 inhabitants.

A first descriptive look at the correlation between educational choice after high school and distance to next university (Table 3) shows that people living nearer to universities are more likely to choose to enrol in a university. For example, the mean distance to the next university is 24.3 kilometres among those who enter vocational education after high school, while it is only 20.6 kilometres among those who enrol in university education. In order to see whether we still find this effect when we control for many other characteristics that might be correlated with the distance, we now turn to the estimation results of the multivariate analysis.

Table 2: Descriptive Statistics

Explanatory Variables	Mean	Std. Dev.
Distance to next university (in km)	22.07	17.71
Distance to next university of applied sciences (in km)	21.45	16.81
Minimum of the two distance measures (in km)	16.53	13.50
Male	0.47	--
Abitur	0.73	--
Father holds university degree	0.35	--
Mother holds university degree	0.26	--
Father does not have any vocational training	0.08	--
Mother does not have any vocational training	0.13	--
Father's education level missing	0.04	--
Mother's education level missing	0.03	--
Net income of parents in euros per year	50,166	24,919
One brother or sister	0.50	--
More than one brother or sister	0.20	--
Town size: medium (20,000 – 100,000 inhabitants)	0.29	--
Town size: large (more than 100,000 inhabitants)	0.32	--
Student population density if university town	18.47	38.63

Note: All values refer to the first period of observation.

Source: SOEP, waves 1993-2006, own calculations.

Table 3: Average distance to next university (in km) for individuals with different educational choices

Transition to…	Distance to next university	Distance to next university of applied sciences
… employment	23.6**	20.5
… vocational training	24.3*	22.8*
… higher education	20.6*	20.5*
No transition	22.6	22.8

* The difference in the distance to the next university between individuals choosing higher education and vocational training is significant at the 1% level. Differences between other groups are not statistically significant based on a two-tailed t-Test.

** The difference in the distance to the next university between individuals choosing employment and those choosing higher education is significant at the 10% level based on a one-tailed t-Test.

Source: SOEP, waves 1993-2006 and HRK database, own calculations.

4 Estimation Results

Table 4 shows the marginal effects of the discrete time hazard rate model of transitions to university. Coefficients are reported in the Appendix (Table A1). We find that the effect of distance to next university/university of applied sciences has a negative effect that is statistically significant at the 5 % level. The magnitude of the marginal effect is -0.002, which means that one additional kilometre of distance to the next university/university of applied sciences decreases the conditional transition probability by 0.2 percentage points.

The effects of other variables are, if significant, as expected as far as their sign is concerned. Baseline dummies indicating period 1 and 2 ("d1" and "d2") are negative (although only d2 is significant). The interaction of the first baseline dummy with the "male" dummy is also negative and significant, suggesting that it takes longer time for males to enrol in higher education than for females. This can be explained with the military or civil service that many men choose to start before university. The variable indicating that a person has a more general university entrance exam (Abitur) instead of a diploma only permitting enrolment in universities of applied sciences is a very strong predictor of the transition to higher education: it increases the transition probability by 20 percentage points. As expected and known from previous literature, two other important variables are mother's and father's education. If the mother or the father holds a university degree, this raises the hazard rate by 7 and 8 percentage points, respectively. Other parental control variables such as whether they have vocational training are not statistically significant. Also parents' income, their family status and the number of siblings are insignificant.

Among the variables indicating the region, we find that living in the southern states of Germany, such as Bavaria and Baden-Wuerttemberg, has a significant effect. Only for individuals in these two states are transition rates into higher education higher than in the reference category ("Midwest", i.e., North Rhine-Westphalia, Hesse, and Rhineland-Palatinate). This finding corresponds with official statistics, showing that, although the number of persons holding a university entrance exam is relatively low in these two states, the share of high school graduates who choose to enrol in higher education is above the national average (Statistisches Bundesamt 2007). The two dummy variables indicating the size of the town at the time of high school graduation ("medium" or "large") are not significant. This suggests that apart from distance, the size of the city, which is correlated with the distinction in urban and rural areas, has no additional explanatory value in determining the transition to

university. Finally, the student density variable is also not significant. We argue that this finding suggests that the distance to the next university plays a role not so much due to the neighbourhood argument but due to the transaction cost argument. It seems to be that the higher costs associated with moving or commuting explain why distance to university plays a major role in the transition to university.

Table 4: Estimation Results (Marginal Effects of a transition to higher education)

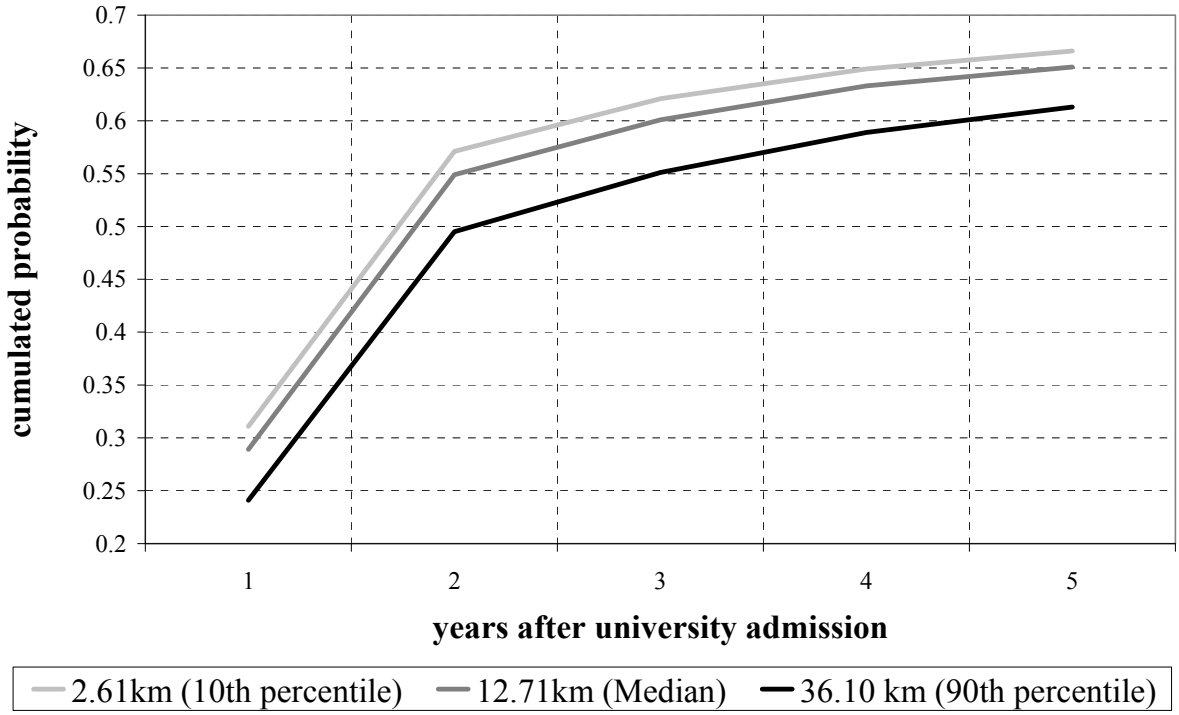
Variable	Marginal Effect	Std. Err.
D1	-0.0435	0.0598
D2	-0.1840	0.0988
D1*male	-0.2197	0.0598
D2*male	0.0480	0.0906
Male	-0.0609	0.0795
Abitur	0.2044	0.0265
Father holds university degree	0.0763	0.0302
Mother holds university degree	0.0669	0.0324
Father does not have any vocational training	0.0151	0.0569
Mother does not have any vocational training	0.0027	0.0449
Net income of parents per year / 1000	0.0070	0.0053
Parents live together	0.0286	0.0336
One sibling	-0.0007	0.0294
More than one sibling	-0.0104	0.0376
Distance to university/university of applied sciences	-0.0024	0.0011
Region 1: City states	-0.0044	0.0542
Region 2: Northwest	0.0277	0.0452
Region 3: East	-0.0162	0.0359
Region 4: South	0.1286	0.0378
Student population density if university town	0.0002	0.0004
Town size: medium (20,000 – 100,000 inhabitants)	0.0316	0.0327
Town size: big (more than 100,000 inhabitants)	0.0027	0.0413
Year dummies and dummies for parents' education information missing (skipped)		
Number of observations:	1877	
Log likelihood:	-1824.7076	

Source: Calculations based on estimations presented in Table A1 in the Appendix.

The marginal effects presented in Table 4 are calculated at the sample mean of all other explanatory variables, including time elapsed to the observed transition. Since we are also interested in the effect of the distance on cumulative transition probabilities, we illustrate the effect of distance to the next university on the cumulative probability graphically in Figure 1. We calculate cumulated transition probabilities to higher education for three different values of minimum distance to next university/university of applied sciences: for 2.6 km, which corresponds to the 10th percentile of the distribution of the distance variable, for 12.7 km, corresponding to the median, and for 36.1 km, corresponding to the 90th percentile. The figure illustrates that the effect of distance is a bit stronger in the first periods after completing high school than in later years. One year after passing the university entrance exam, 28% of all individuals have chosen to enrol in higher education. Holding all other variables constant, individuals living 2.6 km away from the next university/university of applied sciences at the time of high school graduation have a 3 percentage point higher probability of enrolling in university than individuals living 12.7 km away. For those 10% of individuals who live 36.1 or more kilometres away from the next university at the time of high school graduation, the probability of entering higher education is 4 percentage points lower—keeping all other variables constant—than for individuals living 12.7 km away. After five years, on average 65% of all high school graduates with a university entrance exam have chosen to enrol in a university. At that time, the difference between the 10th and the 90th percentile of the distribution of the distance variable amounts to a difference in transition probabilities of 6 percentage points. In other words, a difference of roughly 33 km distance to the next university at the time of high school graduation leads to a 6 percentage point lower probability of having enrolled in higher education 5 years later.

The finding that the effect becomes slightly less important over time is also confirmed by another estimation. As a comparison to the estimation results presented above, we run an estimation on a data set that only considers the first transition after receiving a university entrance exam (i.e. ignoring the possibility that individuals who choose employment or vocational training first and then, after a couple of years, enrol in higher education). In this estimation, we find an even stronger effect for the distance to next university. As can be seen from Table A2b in the Appendix, the marginal effect of the distance variable in this model almost amounts to 0.3 percentage points for every additional kilometre of distance.

Figure 1: Cumulated transition probability to higher education



Source: Figure based on estimations presented in Table A1 in the Appendix.

In the next step, we performed several alternative specifications as sensitivity checks. Since we have information on distance to next university and university of applied sciences and we know which type of higher education individuals choose, we estimate a model in which we split the transitions to higher education into two different risks, namely transitions to universities and transitions to universities of applied sciences. Coefficients and marginal effects of this estimation are reported in Tables A3a and A3b in the Appendix. We find that the distance to the next university still has a significant effect of very similar magnitude as in the first specification on the decision to enrol in a university education in general. The distance to the next university of applied sciences is insignificant, as we expected. However, we cannot find an effect of this variable on the decision to enrol in a university of applied sciences. This might be due to the small number of observations in this group: of the more than 650 individuals enrolling in higher education, we observe only 150 choosing universities of applied sciences.

Another sensitivity check is related to the potential problem of sample attrition. In our context, sample attrition could eventually cause biased estimates: If sample attrition is correlated with moving out of the parental household, and if moving out of the parental

household is correlated with the decision to enrol in a university as well as with the distance to the next university, then considering sample attrition as random might not be adequate. We have performed a sensitivity check that suggests, however, that the problem of sample attrition does not lead to biased estimates in our case. First of all, as Table A4 in the Appendix shows, our sample does suffer from sample attrition, but the problem is not severe in terms of numbers of observations affected. Only 57 out of 1,219 observations leave the sample without transition before the end of the observation period. In order to check whether sample attrition is correlated with distance to next university and thus might bias our estimation results, we estimate a model in which we treat sample attrition as an additional independent risk. Results show that the distance is not significant with respect to these "transitions" (see Tables A5a and A5b in the Appendix). Moreover, the marginal effects regarding the transition to higher education are not affected by including attrition as an independent risk. We therefore conclude that, while sample attrition is present in our sample to a small extent, it does not bias the estimated effect of distance to next university on the probability of enrolling in higher education.

Finally, we checked whether estimation results depend on the functional form of different variables. For example, we estimated a model in which the distance variable enters in linear and quadratic form. These two variables are jointly significant at the 10 percent level and the combined effect is of similar magnitude to that in the linear specification. Moreover, we estimated models with different specifications of the baseline hazard rate. A linear specification of the baseline hazard does not change the results of most variables, including the distance to the next university.

Furthermore, we checked various interaction effects, as was done by Frenette (2004 and 2006): we interacted the distance variable with the education of the parents and various income group variables. In contrast to Frenette (2004 and 2006), however, we could not find any significant effects of these interaction variables. Thus it seems that the distance to university in Germany affects the transition to higher education not only for students from low-income families or families with lower educational backgrounds of the parents. Estimation results of these alternative specifications can be obtained from the authors upon request.

5 Conclusions

This study assesses the role of distance to university for the decision to higher education. To our knowledge, this is the first economic study for Germany taking regional indicators, such as distance, into account. Based on a representative micro-data set for Germany we can conclude that in addition to other well-known indicators, such as parental education and gender, distance does indeed matter. The size of this effect is greater the earlier the individual actually makes the transition to higher education. Moreover, this result is robust to different model specification and subsamples.

In other words, our results show that individuals living farther away are disadvantaged in accessing university.[11] Furthermore, it is mainly the distance to a university and not to a university of applied science that matters. Further research will be needed to show whether this effect is driven mainly by small sample sizes of individuals attending a university of applied sciences or if this effect is related to the greater regional density of these educational institutions. Our results show that a difference of 10 km in distance to the nearest university already explains a 2-3 percentage point difference in the probability of attending a university. For those ten percent of individuals who live 36.1 or more km apart from the next university at the time of their high school degree, the probability of entering higher education is 4 percentage points lower than for individuals living 12.7 km away.

From a theoretical point of view, the distance effect might be explained by a "transaction cost argument" or a "neighbourhood argument" as well. To disentangle these effects, we control for student density in our empirical models as well. This variable should serve as a proxy for a potential effect of individuals wanting to keep up with others in their immediate neighbourhood in educational attainment. However, our estimation results give no empirical evidence for such an explanation. Instead, our results suggest that distance affects educational choices due to transaction costs.

From a policy point of view, our results imply that apart from the other well-known factors that determine who does or does not attend a university in Germany, regional factors should not be ignored. Since it is an official goal of the German federal government to increase the proportion of students up to 40%, which is an increase by about 3.4 percentage points (Bundesregierung 2008), one might argue that politicians should also think about measures to reduce the transaction costs of students who have to study far away from home. For example,

one political instrument could be an increase of housing-related financial aid to students ("Bafög Mietkostenzuschlag") or student loans. Another option to reduce transaction costs could be to increase public funding for the founding of new universities in regions with no universities yet. In Germany, this was the idea underlying a federal initiative in the late sixties and early seventies to found new universities in areas that previously had no university access. Several universities were founded at this time in the Ruhr River region and Bavaria. However, the success of such measures depends on the question of whether additional capacity is filled by local students, especially if there is excess demand in other regions. Other policy options are to increase distance learning programmes or foundations of "Net-Universities". This strategy seems to have significantly increased enrolment rates in the late 1990s in Sweden (see OECD 2006).

Last but not least, further research on distance and regional indicators is needed to support our findings. One further improvement might be to measure distance not only in kilometres but particularly in commuting time and commuting costs. A study utilizing such data and producing similar results would strongly support the theoretical explanations we have proposed to explain our distance effect.

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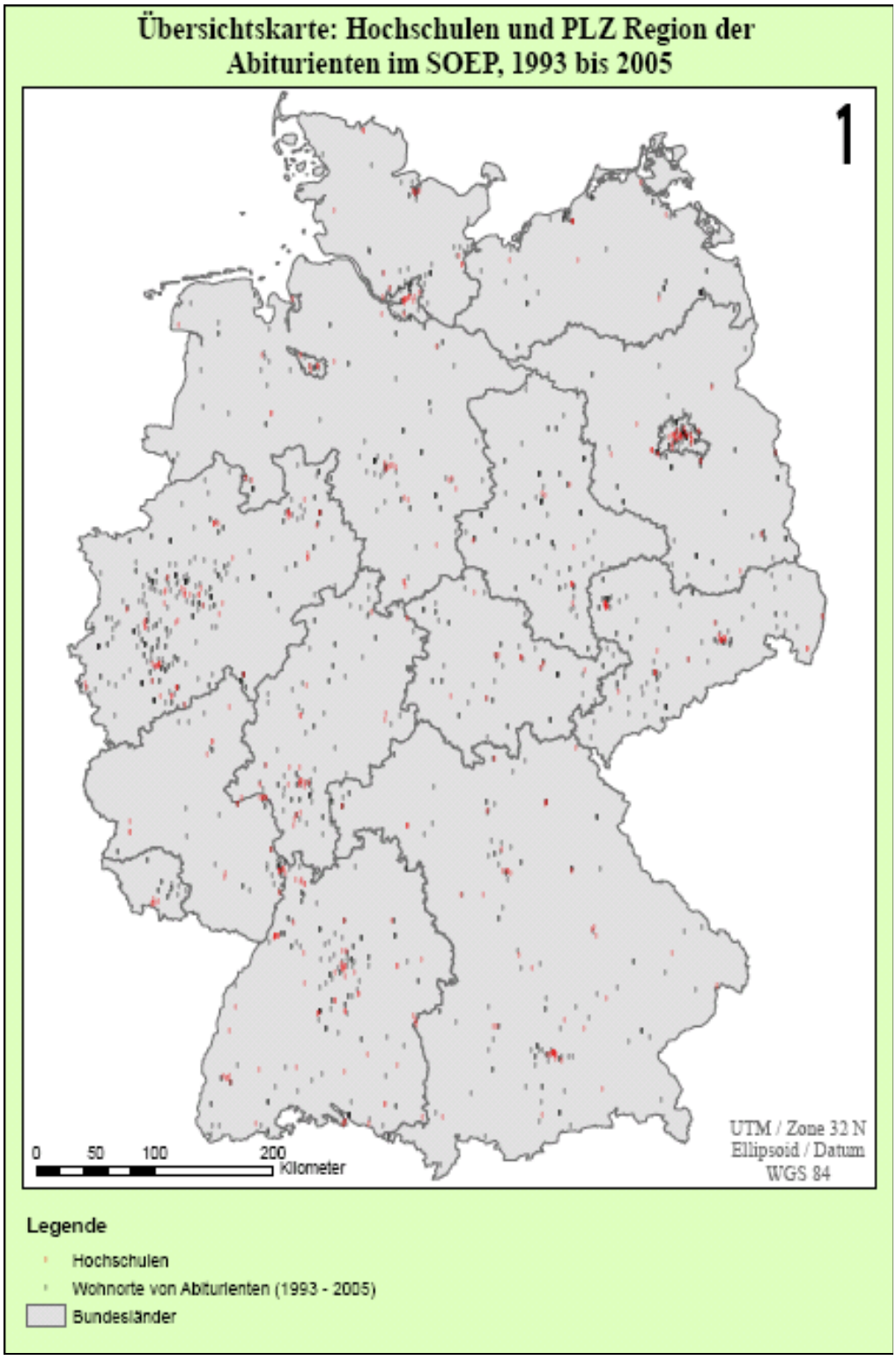
Appendix:

Map: Universities and Zip-code regions of SOEP-respondents with a university entry degree in 1993 to 2005



Legend: Hochschulen = Universities, Wohnorte von Abiturienten = Places of residence of respondents with a university entry degree, Bundesländer = states.

Table A1: Estimation Results of the Basic Specification, Coefficients

Variable	Transition to employment		Transition tovocational training		Transition tohigher education	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
D1	2.4715	1.0738	4.4244	1.0120	0.6986	0.2451
D2	2.9890	1.1392	3.8624	1.0575	0.8915	0.3253
D1*male	-1.8479	1.2591	-4.1045	1.0760	-1.923	0.3237
D2*male	-1.7819	1.3574	-2.3675	1.1202	-0.1419	0.3965
Male	1.0936	1.2209	2.4807	1.0632	0.3352	0.2869
Abitur	-2.2459	0.3232	-0.9700	0.1593	0.6511	0.1657
Father holds university degree	-1.3863	0.5127	-0.6280	0.1893	0.1687	0.1400
Mother holds university degree	-0.6981	0.5369	-0.2690	0.2025	0.2167	0.1480
Father no vocational training	0.0617	0.5908	0.0247	0.2845	0.0734	0.2653
Mother no vocational training	-0.5651	0.5224	-0.1584	0.2414	-0.0342	0.2100
Father's education missing	-0.8550	0.6267	-0.9615	0.4614	-0.0392	0.4021
Mother's education missing	0.9733	0.6443	-0.4276	0.5558	-0.4740	0.4575
Net income of parents per year / 1000	0.1665	0.0511	-0.0423	0.0393	0.0250	0.0249
Parents live together	0.5178	0.4059	0.0421	0.1943	0.1481	0.1629
One sibling	-0.7295	0.3263	-0.2716	0.1643	-0.0833	0.1400
More than one sibling	-0.8701	0.4577	-0.2307	0.2157	-0.1131	0.1792
Distance	-0.0193	0.0129	-0.0035	0.0060	-0.0120	0.0054
Region 1: City-states	0.2317	0.7308	0.2160	0.3236	0.0404	0.2598
Region 2: Northwest	0.4403	0.5113	-0.4005	0.2516	0.0503	0.2060
Region 3: East	1.2260	0.4157	0.1449	0.1992	-0.0007	0.1720
Region 4: South	0.5715	0.4323	-0.4691	0.2168	0.4651	0.1674
Student population density if university town	-0.0099	0.0055	-0.0019	0.0024	0.0003	0.0018
Town size: medium	-0.3450	0.3833	-0.1586	0.1811	0.0952	0.1522
Town size: large	0.2505	0.4428	-0.3963	0.2367	-0.0698	0.1945
University entrance exam obtained in 1993	0.1454	0.7493	-0.6815	0.3712	-0.4499	0.2867
University entrance exam obtained in 1994	0.5866	0.5732	-0.5276	0.3200	-0.9327	0.2839
University entrance exam obtained in 1995	0.0387	0.6443	-0.5893	0.3202	-1.1556	0.2744
University entrance exam obtained in 1996	0.1483	0.6221	-0.5456	0.3359	-0.6767	0.2825
University entrance exam obtained in 1997	-0.4161	0.8546	-0.5798	0.3593	-0.3484	0.2867
University entrance exam obtained in 1998	-0.3152	0.6368	-0.3935	0.2995	-0.8045	0.2702
University entrance exam obtained in 1999	0.6421	0.8484	-0.3077	0.3217	-0.3805	0.2689
University entrance exam obtained in 2000	0.0600	0.6257	-0.1700	0.2759	-0.6062	0.2430
University entrance exam obtained in 2001	0.2906	0.5657	-0.4473	0.2960	-0.5634	0.2437
University entrance exam obtained in 2002	0.3903	0.6011	-0.4266	0.3049	-0.2121	0.2454
University entrance exam obtained in 2003	0.1724	0.5726	-0.2661	0.2895	-0.0891	0.2424
Number of observations:	1877					
Log likelihood:	-1824.7076					

Source: Estimation based on SOEP, waves 1993-2006.

Table A2a: Estimation Results, Dataset considering only the first transition, Coefficients

Variable	Transition to employment		Transition to vocational training		Transition to higher education	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
D1	2.0530	0.8045	3.3289	0.7745	2.5777	0.7679
D2	1.6320	0.8787	2.2963	0.8184	2.0229	0.8013
D1*male	-2.8972	0.9913	-4.3939	0.8823	-4.6229	0.8533
D2*male	-1.0001	1.0723	-1.6108	0.9329	-1.7305	0.8920
Male	1.4418	0.9597	2.3803	0.8664	2.6809	0.8383
Abitur	-1.2880	0.2390	-0.6758	0.1652	0.6555	0.1867
Father holds university degree	-0.6145	0.3163	-0.4852	0.1841	0.1263	0.1646
Mother holds university degree	-0.4090	0.3505	-0.2541	0.1971	0.2779	0.1709
Father no vocational training	0.0816	0.4253	-0.0243	0.2951	0.0777	0.3017
Mother no vocational training	-0.1159	0.3.695	-0.2504	0.2459	-0.0105	0.2420
Father's education missing	-0.7400	0.5569	-1.2147	0.4688	-0.2085	0.4364
Mother's education missing	0.9418	0.5819	-0.3694	0.5492	-0.3097	0.5140
Net income of parents per year / 1000	0.0896	0.0450	-0.0164	0.0361	0.0316	0.0289
Parents live together	0.4974	0.3118	0.2032	0.1942	0.2426	0.1846
One sibling	-0.1526	0.2624	-0.1388	0.1669	-0.0449	0.1612
More than one sibling	-0.1878	0.3410	-0.0799	0.2160	-0.0336	0.2061
Distance	-0.0079	0.0097	0.0013	0.0061	-0.0127	0.0063
Region 1: City-states	-0.0651	0.5264	-0.0056	0.3284	0.0744	0.2922
Region 2: Northwest	0.1471	0.3830	-0.3870	0.2476	0.0189	0.2412
Region 3: East	0.2133	0.3146	-0.1643	0.2014	0.0403	0.1991
Region 4: South	0.0438	0.3190	-0.6054	0.2153	0.4888	0.1946
Student population density if university town	-0.0122	0.0043	-0.0035	0.0023	-0.0004	0.0020
Town size: medium	-0.3028	0.2953	-0.1307	0.1823	0.1434	0.1777
Town size: large	0.3121	0.3426	-0.3516	0.2369	0.0583	0.2252
University entrance exam obtained in 1993	1.4131	0.6070	0.6819	0.3718	0.2656	0.3630
University entrance exam obtained in 1994	1.2790	0.5197	0.3865	0.3264	-0.3418	0.3341
University entrance exam obtained in 1995	0.8078	0.5242	-0.1383	0.3163	-0.9636	0.3070
University entrance exam obtained in 1996	0.9935	0.5158	-0.1175	0.3363	-0.6125	0.3170
University entrance exam obtained in 1997	0.6907	0.6270	0.1557	0.3546	-0.1273	0.3344
University entrance exam obtained in 1998	1.4059	0.5034	0.4800	0.3118	-0.3377	0.3168
University entrance exam obtained in 1999	-0.1150	0.7167	0.1861	0.3226	-0.0432	0.3033
University entrance exam obtained in 2000	0.6453	0.5217	0.1252	0.2779	-0.5169	0.2665
University entrance exam obtained in 2001	1.1412	0.4813	0.1430	0.2918	-0.4204	0.2764
University entrance exam obtained in 2002	0.9813	0.5044	-0.1795	0.3048	-0.1599	0.2652
University entrance exam obtained in 2003	0.7273	0.5014	-0.0299	0.2899	-0.0001	0.2589
Number of observations:	1676					
Log likelihood:	-1793.8435					

Source: Estimation based on SOEP, waves 1993-2006.

Table A2b: Estimation Results, Dataset considering only the first transition, Marginal Effects

Variable	Transition to higher education	
	Marginal Effect	Std. Err.
D1	0.2613	0.1059
D2	0.1533	0.2124
D1*male	-0.4459	0.0973
D2*male	-0.2166	0.1241
Male	0.3292	0.1560
Abitur	0.2096	0.0273
Father holds university degree	0.0795	0.0320
Mother holds university degree	0.0919	0.0343
Father no vocational training	0.0178	0.0591
Mother no vocational training	0.0203	0.0479
Father's education missing	0.0415	0.0941
Mother's education missing	-0.0658	0.0907
Net income of parents per year / 1000	0.0067	0.0056
Parents live together	0.0279	0.0348
One sibling	0.0048	0.0306
More than one sibling	0.0027	0.0393
Distance	-0.0028	0.0012
Region 1: City-states	0.0182	0.0567
Region 2: Northwest	0.0314	0.0484
Region 3: East	0.0184	0.0383
Region 4: South	0.1608	0.0406
Student population density if university town	0.0004	0.0004
Town size: medium	0.0486	0.0348
Town size: large	0.0355	0.0437
Year Dummies (skipped)		

Source: Estimations presented in Table A2a (above).

Table A3a: Estimation Results for Alternative Specification: Split Transition to University and University of Applied Sciences, Coefficients

Variable	Transition to employment		Transition to vocational training		Transition to university		Transition to university of applied sciences	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
D1	2.4888	1.0721	4.4184	1.0204	0.6024	0.2777	0.8313	0.4263
D2	3.0326	1.1372	3.8726	1.0578	0.7339	0.3651	1.2041	0.5297
D1*male	-1.8931	1.2600	-4.1146	1.0764	-1.8960	0.3757	-1.9236	0.5272
D2*male	-1.901	1.3572	-2.4282	1.1203	0.2250	0.4457	-0.9797	0.6318
Male	1.1800	1.222	2.5231	1.0634	0.0505	0.3333	0.9373	0.4717
Abitur	-2.2573	0.3245	-0.9537	0.1599	2.2130	0.2955	-0.9984	0.2120
Father holds univ. deg.	-1.3972	0.5113	-0.6258	0.1891	0.2470	0.1537	-0.0230	0.2313
Mother holds univ. deg.	-0.6840	0.5373	-0.2731	0.2025	0.0944	0.1621	0.5317	0.2411
Father no voc. training	0.0198	0.5900	0.0055	0.2847	0.1358	0.3055	-0.1131	0.4127
Mother no voc. training	-0.5753	0.5199	-0.1597	0.2417	-0.1052	0.2427	0.0237	0.3217
Father's educ. missing	-0.8071	0.6270	-0.9366	0.4632	0.2007	0.4862	-0.3853	0.6326
Mother's educ. missing	0.9367	0.6441	-0.4552	0.5579	-0.5747	0.5348	-0.3560	0.7743
Net income / 1000	0.1660	0.0514	-0.0429	0.0393	0.0190	0.0272	0.0284	0.0407
Parents together	0.5679	0.4092	0.0552	0.1949	0.0543	0.1823	0.3664	0.2679
One sibling	-0.7438	0.3266	-0.2801	0.1646	-0.0925	0.1570	-0.1348	0.2179
More than one sibling	-0.8956	0.4583	-0.2368	0.2160	-0.0643	0.1994	-0.3131	0.2887
Distance to university	-0.0074	0.0102	0.0023	0.0050	-0.0094	0.0050	0.0004	0.0066
Distance to university of applied sciences	-0.0116	0.0106	-0.0053	0.0051	0.0002	0.0047	-0.0042	0.0069
Region 1: City-states	0.2119	0.7344	0.2096	0.3248	-0.0787	0.2840	0.4587	0.4397
Region 2: Northwest	1.2691	0.4192	-0.3717	0.2525	-0.0620	0.2298	0.2074	0.3405
Region 3: East	0.4710	0.5146	0.1420	0.2016	-0.1345	0.1933	0.4122	0.2845
Region 4: South	0.5942	0.4354	-0.4850	0.2182	0.4414	0.1878	0.6391	0.2681
Student population density if university town	-0.0098	0.0055	-0.0016	0.0024	0.0011	0.0020	-0.0018	0.0033
Town size: medium	-0.3391	0.3799	-0.1655	0.1811	0.1109	0.1715	0.1598	0.2316
Town size: large	0.2092	0.4439	-0.4060	0.2384	-0.0082	0.2186	-0.0952	0.3265
University adm. 1993	0.137	0.7516	-0.6746	0.3719	-0.4216	0.3205	-0.4368	0.4533
University adm.1994	0.6256	0.5729	-0.5108	0.3198	-1.2293	0.3336	-0.3272	0.4086
University adm. 1995	0.0821	0.6441	-0.5787	0.3204	-1.1639	0.3029	-1.0719	0.4815
University adm. 1996	0.1884	0.6223	-0.5258	0.3361	-0.7603	0.3199	-0.4540	0.4305
University adm. 1997	-0.4325	0.8574	-0.5733	0.3599	-0.3274	0.3154	-0.3337	0.4559
University adm. 1998	-0.2468	0.6377	-0.3512	0.2997	-0.8167	0.3049	-0.6780	0.4210
University adm. 1999	-0.6563	0.8507	-0.3040	0.3220	-0.3514	0.2936	-0.4447	0.4487
University adm. 2000	0.0977	0.6287	-0.1474	0.2765	-0.9294	0.2775	0.0870	0.3517
University adm. 2001	0.2252	0.5706	-0.4528	0.2971	-0.4943	0.2632	-0.8653	0.4517
University adm. 2002	0.3364	0.6029	-0.4397	0.3063	-0.0677	0.2628	-0.7959	0.4560
University adm. 2003	0.1663	0.5750	-0.2705	0.2901	-0.1449	0.2677	0.0932	0.3587
Number of observations:	1877							
Log likelihood:	-2083.6083							

Source: Estimation based on SOEP, waves 1993-2006.

Table A3b: Estimation Results for Alternative Specification: Split Transition to University and University of Applied Sciences, Marginal Effects

Variable	Transition to university		Transition to university of applied sciences	
	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.
D1	-0.0414	0.0436	-0.0016	0.0292
D2	-0.1275	0.0553	-0.0333	0.0386
D1*male	-0.1302	0.0041	-0.0595	0.0281
D2*male	0.1130	0.0855	-0.0490	0.0312
Male	-0.0921	0.0583	0.0315	0.0374
Abitur	0.2907	0.0172	-0.0965	0.0225
Father holds university degree	0.0654	0.0245	0.0038	0.0181
Mother holds university degree	0.0147	0.0248	0.0519	0.0233
Father no vocational training	0.0244	0.0498	-0.0113	0.0292
Mother no vocational training	-0.0106	0.0360	0.0069	0.0265
Father's education missing	0.0702	-0.0683	-0.0223	0.0399
Mother's education missing	-0.0683	0.0614	-0.0156	0.0524
Net income of parents per year / 1000	0.0034	0.0041	0.0034	0.0032
Parents live together	-0.0006	0.0277	0.0250	0.0174
One sibling	-0.0007	0.0235	-0.0041	0.0169
More than one sibling	0.0048	0.0303	-0.0189	0.0199
Distance to next university	-0.0016	0.0076	0.0002	0.0005
Distance to next university of applied sciences	0.0003	0.0007	-0.0003	0.0005
Region 1: City-states	-0.0288	0.0383	0.0410	0.0460
Region 2: Northwest	-0.0050	0.0345	0.0241	0.0317
Region 3: East	-0.0384	0.0273	0.0335	0.0253
Region 4: South	0.0735	0.0324	0.0556	0.0273
Student population density if university town	0.0003	0.0003	-0.0001	0.0003
Town size: medium	0.0215	0.0267	0.0142	0.0191
Town size: large	0.0126	0.0336	-0.0022	0.0254
Year Dummies (skipped)				

Source: Estimations presented in Table A3a (above).

Table A4: Number of observations without transition into employment, vocational training or higher education by year of high-school graduation

Year of university entrance exam	Number of periods observed						Number of observations dropping out of the sample without transition before the end of the observation period
	1	2	3	4	≥ 5	Total	
1993	0	0	1	0	0	1	1
1994	0	2	1	1	1	5	4
1995	0	1	3	0	2	6	4
1996	1	2	0	1	0	4	4
1997	2	1	0	0	0	3	3
1998	7	0	1	0	0	8	8
1999	0	0	0	0	0	0	0
2000	5	0	0	1	1	7	6
2001	3	2	0	0	0	5	5
2002	7	1	0	0	0	8	8
2003	2	2	4	0	0	8	4
2004	10	7	0	0	0	17	10
2005	47	0	0	0	0	47	0
Total	**84**	**18**	**10**	**3**	**4**	**119**	**57**

Source: SOEP, waves 2000-2006

Table A5a: Estimation Results for Alternative Specification: Sample Attrition as additional independent competing risk, Coefficients

Variable	Transition to employment		Transition to vocational training		Transition to higher education		„Transition" to sample attrition	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
D1	2.6298	1.0659	4.5275	1.0183	0.9852	0.2399	-0.1527	0.5315
D2	3.2805	1.1374	4.0668	1.0590	1.2434	0.3315	1.0226	0.6509
D1*male	-1.997	1.2509	-4.0552	1.0752	-1.9676	0.3230	0.6941	0.8326
D2*male	-2.0739	1.3540	-2.4878	1.1221	-0.3536	0.4037	-0.4877	1.0026
Male	1.2160	1.2128	2.4262	1.0621	0.3753	0.2853	-0.8578	0.7562
Abitur	-2.2012	0.3163	-0.9771	0.1596	0.6221	0.1655	-0.2184	0.3427
Father holds univ. deg.	-1.3988	0.5088	-0.6372	0.1896	0.1314	0.1398	0.0915	0.3659
Mother holds univ. deg.	-0.5634	0.5268	-0.2513	0.2022	0.2495	0.1478	0.5439	0.3703
Father no voc. training	0.1111	0.5807	0.0216	0.2867	0.0431	0.2654	0.2850	0.5512
Mother no voc. training	-0.4983	0.5038	-0.1735	0.2414	-0.0943	0.2093	0.4487	0.4497
Father's educ. missing	-0.6304	0.6226	-0.7622	0.4740	0.0542	0.4172	1.0279	0.6294
Mother's educ. missing	0.8114	0.6388	-0.6764	0.5565	-0.8100	0.4625	-1.7099	1.1594
Net income / 1000	0.1834	0.0503	-0.0253	0.0387	0.0567	0.0248	0.0583	0.0528
Parents together	0.4503	0.4013	-0.0206	0.1960	0.1237	0.1636	-0.6449	0.3412
One sibling	-0.8473	0.3202	-0.3544	0.1654	-0.1574	0.1412	-0.7227	0.3056
More than one sibling	-1.0318	0.4525	-0.3443	0.2164	-0.2616	0.1795	-1.7281	0.5288
Distance	-0.0173	0.0124	-0.0023	0.0060	-0.0103	0.0053	0.0111	0.0122
Region 1: City-states	-0.0036	0.7240	0.1618	0.3211	0.0520	0.2561	-1.5642	0.7805
Region 2: Northwest	0.3641	0.5040	-0.4050	0.2531	0.0313	0.2078	-0.1687	0.4382
Region 3: East	1.0529	0.4062	0.0750	0.1996	-0.0914	0.1725	-1.225	0.4276
Region 4: South	0.5167	0.4248	-0.5242	0.2179	0.3965	0.1673	-0.6189	0.4341
Students' density if university town	-0.0093	0.0055	-0.0016	0.0024	0.0004	0.0018	-0.0004	0.0037
Town size: medium	-0.3571	0.3744	-0.1747	0.1802	0.0562	0.1511	-0.3246	0.3920
Town size: large	0.2775	0.4343	-0.4100	0.2364	-0.1324	0.1937	0.4926	0.4356
Number of observations:	1877							
Log likelihood:	-2026.2577							

Source: Estimation based on SOEP, waves 1993-2006.

Table A5b: Estimation Results for Alternative Specification: Sample Attrition as additional independent competing risk, Marginal Effects

Variable	Transition to higher education		„Transition“ to sample attrition	
	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.
D1	0.0074	0.0588	-0.0257	0.0147
D2	-0.1593	0.1073	-0.0135	0.0097
D1*male	-0.2334	0.0591	0.0526	0.0365
D2*male	0.0088	0.0884	-0.0024	0.0202
Male	-0.0453	0.0802	-0.0335	0.0213
Abitur	0.2046	0.0266	-0.0032	0.0080
Father holds university degree	0.0691	0.0299	0.0036	0.0086
Mother holds university degree	0.0687	0.0320	0.0128	0.0105
Father no vocational training	0.0054	0.0559	0.0067	0.0153
Mother no vocational training	-0.0146	0.0437	0.0143	0.0145
Father’s education missing	0.0317	0.0916	0.0424	0.0357
Mother’s education missing	-0.1377	0.0764	-0.0183	0.0080
Net income of parents per year / 1000	0.0128	0.0052	0.0009	0.0012
Parents live together	0.0334	0.0333	-0.0201	0.0122
One sibling	-0.0057	0.0293	-0.0139	0.0072
More than one sibling	-0.0274	0.0370	-0.0249	0.0061
Distance	-0.0022	0.0011	0.0004	0.0003
Region 1: City-states	0.0098	0.0543	-0.0208	0.0057
Region 2: Northwest	0.0258	0.0451	-0.0029	0.0089
Region 3: East	-0.0246	0.0356	-0.0215	0.0070
Region 4: South	0.1208	0.0373	-0.0136	0.0069
Students’ density if university town	0.0002	0.0004	0.0000	0.0001
Town size: medium	0.0266	0.0322	-0.0067	0.0078
Town size: large	-0.0153	0.0405	0.0153	0.0122

Source: Estimations presented in Table A5a (above).

Endnotes

[1] There are various studies in the field of sociology that show the same high correlation between parental background and participation in higher education (for instance, Blossfeld 1993, Müller and Haun 1994 or more recent studies by Becker 2000).

[2] However, there are studies in the field of development economics analysing distance effects as one influence among others on childrens` school enrolment (for a most recent study on this, see e.g., Vuri 2008).

[3] There are a few studies based on particular regions, such as the study by Andres and Looker (2001), who focus on the distance to university in two Canadian provinces. Furthermore one might also refer to the literature on the availability of other infrastructural services, such as hospitals or libraries: see, for instance, Shannon et al. (1986) or McLafferty (1982).

[4] Of course, for other students, added distance between the home and the university may be seen as an advantage if they desire more independence from their parents. But even if the students do not leave their parents' home to go to the university, there are transaction costs in the form of more or less daily commuting costs, which increase with distance to university.

[5] In a similar context Frenette (2006: 50) refers to a "neighbourhood educational attainment effect" without going into more details and without controlling for it in his estimations.

[6] We are not able to disentangle a "peer group effect" from an "information effect" explaining a "neighbourhood effect".

[7] Steiner and Wrohlich (2008) estimate a very similar model of the transition to higher education, including only two competing risks, vocational training and higher education.

[8] See Wagner et al. (2007) and http://www.diw.de/soep for more information on the SOEP.

[9] Only for one respondent was it impossible to determine the centre of gravity due to invalid zip code information.

[10] There are 440 counties ("Kreise") in Germany.

[11] In principle, there might be a "sorting effect" (see Chau 2004, who discusses this in more detail in his analysis). Since families may choose to sort into different areas, the presence of a university may be endogenous. Families who value education more highly, for instance, may sort into areas where local universities exist. First of all we try to minimize such a potential problem by including regressors such as the education of the parent and their income. Second, in the German context in particular, where individuals' moving probabilities are much lower than, for instance, in the US, we argue that the moving behaviour of households is mainly dominated by factors related to the employment of the parents and not other factors.