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Titel **"GENDER, REGIONAL AND SOCIAL DIFFERENCES AT THE TRANSITION FROM LOWER TO UPPER SECONDARY EDUCATION**

AN ANALYSIS IN THE CONTEXT OF THE FAMSIM+ FAMILY MICROSIMULATION MODEL FOR AUSTRIA"

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Content

Abstract

The central aim of this paper is to reveal differences in educational placement at the transition from lower to upper secondary education, such as gender differences, differences caused by the education of parents, the place of living (rural vs. urban areas) as well as by the type of school attended in lower secondary education ('Hauptschule' vs. 'AHS'). Beside a descriptive analysis, this paper develops a model of the second educational choice in the form of a logistic regression model with multiple outcome that can be directly employed in the FAMSIM+ microsimulation project, currently developed at the Austrian Institute for Family Studies.

1 Introduction

This ÖIF working paper focuses on the second educational choice usually made at the age of 14 at the transition point from lower to upper secondary education. While the first choice, as analyzed in Spielauer et. al. (2002a), is basically a choice between two types of schools, namely between the lower secondary school (Hauptschule) and the lower secondary academic school (AHS), educational career paths meet again at this point in order to branch to a wide set of school types and apprenticeships. Like the preceding paper on the first educational choice, this paper is written within the framework of the FAMSIM+ family microsimulation model currently developed at the Austrian Institute for Family Studies. In this respect, beside a descriptive analysis, this paper develops a model of the second educational choice in the form of a logistic regression model with multiple outcome that can be directly employed in the FAMSIM+ microsimulation project.

On the macro level, an educational expansion has been observed over the past 25 years. There has been a steady decline in the share of persons with compulsory schooling as their highest qualification level. Currently, their share in the total population is at about one third. Of the residential population aged 20-24, currently only about 17% have not obtained any qualification beyond compulsory schooling. This educational expansion is also reflected in the first educational choice with the share of children entering lower secondary academic school (AHS) almost doubling in the last three decades. These phenomena on the macro level are the outcome of the decisions of the individual agents on the micro level. In our preceding paper on the first educational choice, we found surprisingly stable behavioral relation on the micro level that actually moved the explanation of the changes on the macro level to the changing educational composition of the parents' generation: the (first) school choice in dependence on parental educational attainment stayed almost unchanged for all age cohorts since the 1960s. For example, 80% of those whose parents have a university degree and only 10% of those whose parents have just compulsory education graduated from a lower academic secondary school – with these rates staying almost unchanged for decades. In this paper we investigate the behavioral relations regarding the second educational choice, that is, the impact of gender, regional and social differences as well as the first educational choice made on the second choice. Again we find surprisingly stable relations on the micro level for the last two decades. Microsimulation allows to project these dynamics in a straightforward way, as family links are maintained allowing to include parents' characteristics into the model of individual school choices, as well as geographical variables allowing to account for urban-rural differences. Regarding the latter, considerable differences have been found regarding the first educational choice, with the share of children going to lower academic secondary school being 20% points higher (and therefore currently being double as high) in urban areas. What impact has the first school choice on the second? One might expect that the higher rate of children attending the Hauptschule in rural areas will result in higher transition rates from the Hauptschule to schools leading to the final exam (Matura) in rural areas. Our findings point into the opposite direction.

The simulation of educational careers is part of almost all 'general' microsimulation models, that is, models that are not specialized for a very limited purpose but produce detailed household projections containing various socioeconomic and family characteristics.

Education plays a crucial role in such projections, as it was identified as the single most important variable besides age and sex in determining fertility and mortality (Lutz 1999). Regarding the timing of life events, most other life careers (e.g. household formation, marriage and parenting) usually start after leaving school, while in economic modeling, education is a key determinant of human capital and therefore of income and job careers. Education attainment is an indicator of differences between individuals in many dimensions: it might be a measure of talent, income potential, social status and class as well as individual autonomy, i.e. independence of partners and, perhaps, also of general norms in society (Hoem et.al., 2001). In the context of most microsimulation models, education constitutes the first individual career that is simulated, as formal education starts early in life.

Existing microsimulation models differ considerably in their ways of modeling educational careers, ranging from rather simple approaches that summarize education using a few variables (e.g. school leaving age and/or highest grade) to the detailed reproduction of national school systems and all possible transition paths. It is an interesting observation, that the simulation of detailed school types is central in models with focus on demographic processes like the Canadian LifePaths model. In LifePaths, education is modelled in detail including 30 possible post-secondary education fates as well as 100 possible fields of study. A second distinction can be made regarding the variables that enter the behavioral model of school choices. Many models use simple transition tables generated from cross-sectional observations of a year. MOSART developed at Statistics Norway (Fredriksen 1998) is an example of this approach, in that education activities are based on observed rates of a given year (and are kept constant in the projection). In contrast, the French DESTINIE model – beside its use as pension model it is currently also increasingly used for demographic research - does not simulate educational transitions at all but models school leaving age as proxy of educational attainment. In doing so, unlike other models, DESTINIE includes parents' educational attainment into the behavioral model. As our analysis shows, parents' characteristics and rural urban differentials play an important role regarding school choices in Austria and a model taking the changing population composition regarding the educational attainment of parents into account might create more realistic forecasts than models assuming unchanged transition rates as observed today. It will be one of the next fascinating tasks to apply these models of educational choices to project future dynamics and compare the simulation results to the benchmark scenario of unchanging rates – and with reality.

2 An Overview of the Austrian Secondary Education Scheme

In Austria, children from the age of six to ten usually attend primary school, which provides them with common basic education. After primary school, at lower secondary level, two possibilities of further school attendance exist: Lower secondary school ('Hauptschule') and lower secondary academic school ('AHS'), both covering a period of four years. Having completed grade eight of schooling, there are different options doing the requested compulsory school attendance of nine years: the last year of compulsory education can be completed in pre-vocational schools ('Polytechnische Schule'), in grade one of the secondary vocational and technical schools or ,alternatively, in the fifth year of AHS.

Higher secondary level offers several possibilities for further education. The apprenticeship ('Lehre'), taking three to four years, enables dual education. It provides alternately specific job-related training according to the chosen occupation in firms, in addition to overall schooling. Another option are secondary vocational and technical schools ('BMS'), which generally last three years and lead to a certificate. Students attending secondary vocational and technical colleges ('BHS', 'HTL') are required to do a final exam after five years of successful schooling, called 'Reifeprüfung' or 'Matura', which is essential for accessing post-secondary level education. Secondary vocational colleges are primarily commercial academies, while secondary technical colleges allow specialization in certain technical industries. Additionally, there are sometimes a few months of practical in-company training required for obtaining a degree. A further alternative is the secondary academic school ('AHS'), which provides its attendants mainly with general knowledge. Its upper level takes four years and successful graduation also requires passing the 'Matura'. The 'Matura' certificate enables its holders to attend university, 'Fachhochschule' (academy), or various other post-secondary colleges or academies.

Table 2.1 provides a general overview of the transition from lower to upper secondary education in Austria for two different age cohorts. They show that the percentage of people without any further education decreased substantially from 29.0% to 16.2%. As a consequence the proportion of individuals holding a 'Matura' certificate and, thus, graduated from secondary vocational and technical college or secondary academic school, rose from 14.8% to 25.3%. Apprenticeship as well as vocational and technical schools maintained their importance over time.

Table 2.1: Transition rates to secondary education for the age cohorts 1936 – 1955 and 1956 – 1975 (in percent)

Years of birth	Secondary education				
	No further education	Apprentice	Vocational and technical school	Vocational and technical college	Academic school
1936 to 1955 (n = 11 605)	29.0	43.9	12.3	5.6	9.2
1956 to 1975 (n = 9 900)	16.2	45.1	13.4	11.0	14.3

3 Data and Variables

The data source for our evaluation was the special program of the Austrian microcensus from June 1996, which contained a questionnaire on education history, marriage, and biography of births. For our analyses the questions of interest were:

- Kind of graduation in compulsory education
- All kinds of ever attended/started educations following compulsory education
- Educational history starting from lower secondary education
- Highest education of the individual's parents
- Municipality type rural or urban (place where person lived at the age of fifteen)

Table 3.1: Variable description

Variable	Description	Type
gender	Gender	Categorical with the categories 0 female 1 male
municip	Municipality type, where lived at age of fifteen	Categorical with the categories 0 rural 1 urban
educ_com	Compulsory education	Categorical with the categories 0 Lower secondary school ('Hauptschule') 1 Lower academic secondary school ('AHS')
educ_sec	Highest secondary education of the individuals interviewed	Categorical with the categories 0 no further education[1] 1 apprenticeship 2 secondary vocational and technical school 3 secondary vocational and technical college 4 secondary academic school
educ_par	Education of parents (highest value of father or mother)	Categorical with the categories 1 compulsory 2 apprenticeship 3 vocational 4 matura[2] 5 university
gew1	Adjusted weight by the population structure of the total population of Austria	Real

In contrast to the basic program of the microcensus, the special program is voluntary. Since individuals for various reasons refuse to answer the questionnaire, due to lack of interest or embarrassment, we have to consider a systematic error. Particularly in a survey on

[1] The category *no further education* contains all individuals who didn't start any school or training after graduating from compulsory school, or dropped out of secondary education and never graduated from another school.

[2] In Austria, the 'Matura' (or 'Reifeprüfung') is a final exam in upper level academic secondary schools and secondary technical and vocational colleges, usually taken after 12 resp. 13 years of education. Matura also grants admission to universities or Fachhochschulen (post-secondary colleges).

education, we can expect less interest in the program from individuals with a lower educational level; consequently, some caution in usage of the results is advisable. However, since we evaluate individual behavior in dependency of influence factors, it is not as much important that a certain distribution in the sample (i.e. highest education) is equivalent to this distribution in the total population but the individual behavior in the sample fits the behavior of the individuals in the total population. Especially for the logistic regression, conducted in this paper, the systematic error is therefore irrelevant, inasmuch as the non-respondents explain the same behavior as the respondents.

4 Gender, Regional and Social Differences in Secondary Education

It is an established knowledge that gender, residential area and social background have a substantial influence on education. That is to say, individuals whose parents have a higher education are more likely to attend academic schools and colleges, whereas individuals of parents with only compulsory education are more likely to leave school without any further education. It is one purpose of this paper to look into this issue further, but in a different perspective to previous studies on this subject. Since we possess educational history data from primary school to university, we are able to identify individuals at the micro level at a the transition from lower to upper secondary education. This enables us to investigate influence factors such as gender, residential area, education of parents and previous education at this particular transition point.

To detect structural changes in secondary education over time, the effect of these factors has been examined for two age cohorts, namely individuals born 1936 to 1955, who attended secondary education in the time period from 1950 to 1970, and individuals born 1956 to 1975, who attended secondary education in the time period from 1971 to 1990. Individuals born in 1975 were twenty-one years old at the time when the microcensus survey was conducted in 1996, and thus should already have finished secondary education at that time.

4.1 Gender Differences

First, we investigate the extend of gender differences at the transition to upper secondary education. Figure 4.1 shows these differences for individuals born between 1956-75. While differences are negligible at vocational and technical colleges and academic schools, there are clear gender disparities regarding *no further education* as well as those school types, where graduation does not require a 'Matura' certificate. While more than half of males completed an apprenticeship, females more often attended secondary vocational and technical schools. Moreover, 21.5% of females do not have any further education, compared with 11.8% of males.

Comparison of Figure 4.1 and Figure 4.2 reveals several changes over time. While the percentage of individuals without further education decreased dramatically, independently of their gender, secondary academic school gained popularity, especially for females, who represent 13.3% of graduates of the age cohort 1956-75. However, gender-proportions hardly changed regarding secondary vocational and technical schools, as well as secondary vocational and technical colleges or apprentices.

Figure 4.1: Transition rates to secondary education for females and males for the age cohort 1956-75

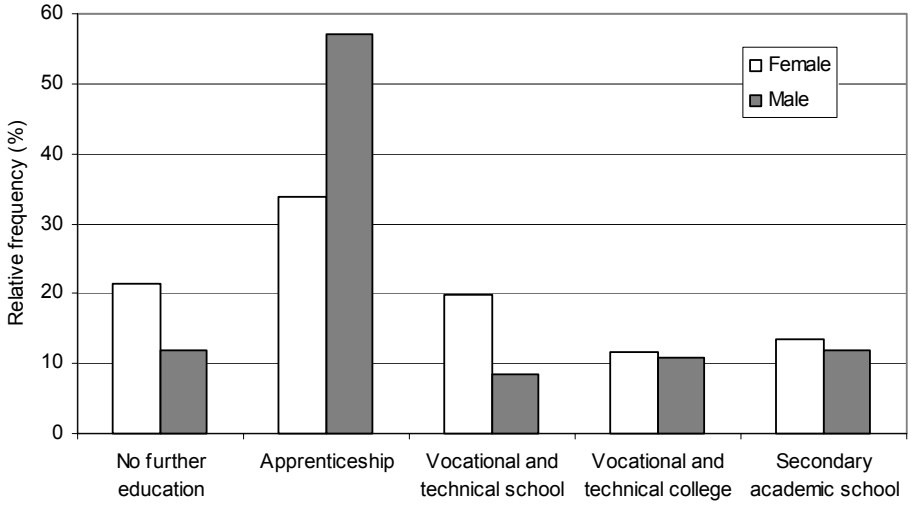
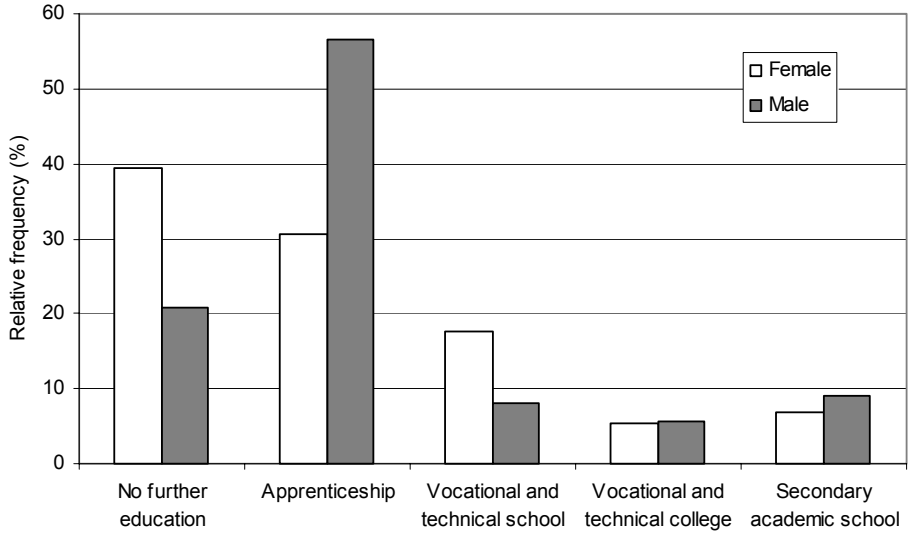


Figure 4.2: Transition rates to secondary education for females and males for the age cohort 1936-55



4.2 Regional Differences

Since in rural regions the provision of colleges and academic schools is limited, we can expect disadvantages in educational placement at the transition to secondary education for country dwellers. Figure 4.3 shows a notable difference between rural and urban municipalities for individuals visiting academic schools. While in rural areas only 8.5% graduated from this school type, 22% did so in urban areas. Being an apprentice seems to be more common in rural than in urban areas, although this form of secondary education is the most frequently chosen one in both regions.

Figure 4.3: Transition rates to secondary education for rural and urban areas for the age cohort 1956-75

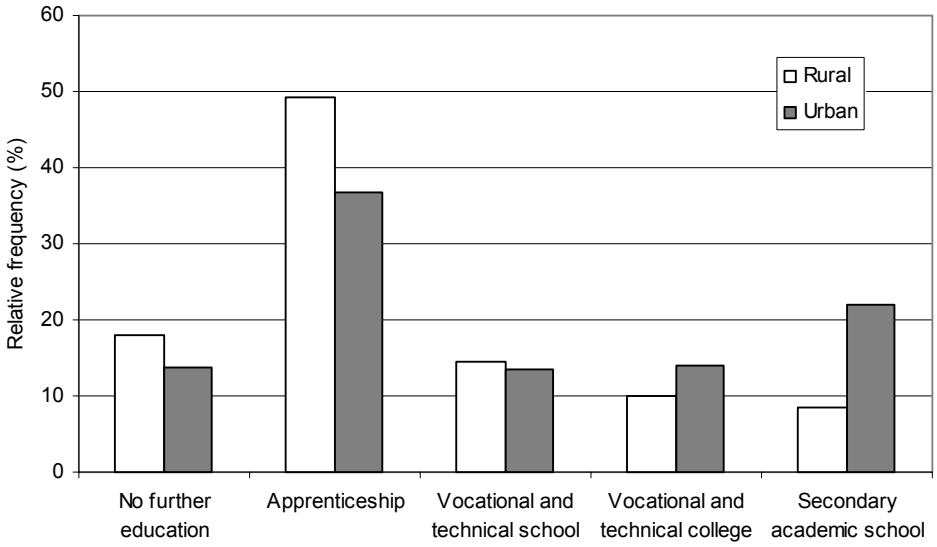
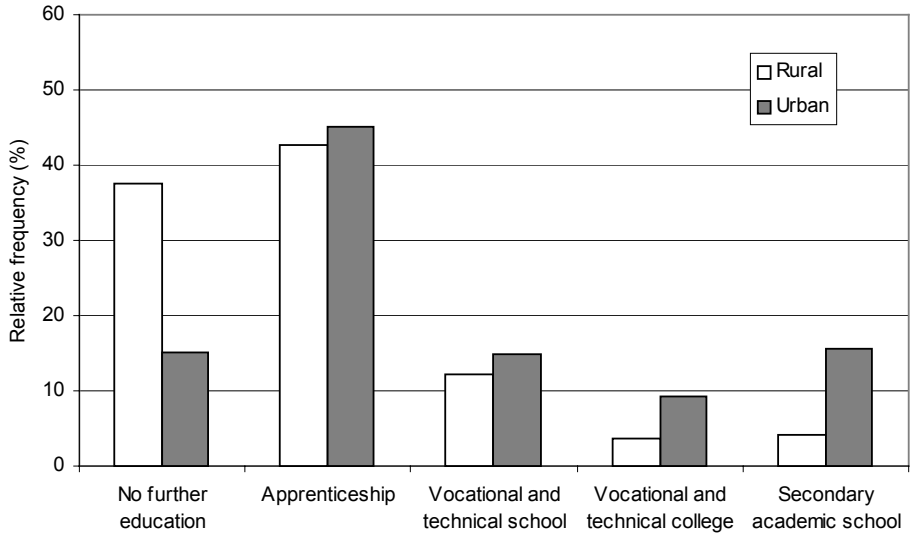


Figure 4.4: Transition rates to secondary education for rural and urban areas for the age cohort 1936-55



For rural areas, Figure 4.3 and Figure 4.4 show a significant reduction of individuals with no further education from 38% to 18%, while in urban regions the decrease was only marginal. Another educational shift took place regarding apprentices: While in rural areas the percentage of apprentices increased further over the years, it fell in urban regions from 45% to 37%. In both municipality types a general tendency towards education forms which require a 'Matura' certificate is apparent.

4.3 Effect of the Educational Level of Parents

Results from a previous working paper (Spielauer et al., 2002) have shown that education of parents strongly influences individual's educational placement in lower secondary education. At this point, the effect of the educational attainment of parents at the transition to upper

secondary education is of interest. In Figure 4.5 the strong influence of the education of parents on secondary education can clearly be seen. The majority of those students whose parents are university graduates attended secondary academic schools (63%), but only 5% did so, when their parents have compulsory education. On the contrary, while about 50% of those whose parents have compulsory education or an apprenticeship training did an apprenticeship, only 8.3% of those whose parents hold a university degree did so. Vocational and technical colleges are preferred by those whose parents have this kind of education themselves. The most disadvantaged subgroup are those whose parents have compulsory education only, given that 75% of these individuals left school without any further education or did an apprenticeship, whereas nearly 80% of those whose parents have a university degree got a 'Matura' diploma (colleges and academic schools).

Figure 4.5 and Figure 4.6 show the effect of the education of parents minor changes only from age cohort 1936-1955 to cohort 1956-1975. Considerable alteration can be observed for individuals of parents with compulsory education, since the high proportion of 40.3% of those without any further education decreased to 24%. As apprenticeships increased over time, it gives the impression that these individuals did apprentices instead. Another noticeable change occurred for individuals whose parents graduated from university, where the transition rates to colleges and academic schools ('Matura') rose from 70% to 80%. The disadvantage of individuals of parents with lower education barely changed over time. As a result the statement "the higher the education of parents, the higher the chance of an individual for having a better educational career" still applies.

Figure 4.5: Transition rates to secondary education conditional on education of parents for the age cohort 1956-75

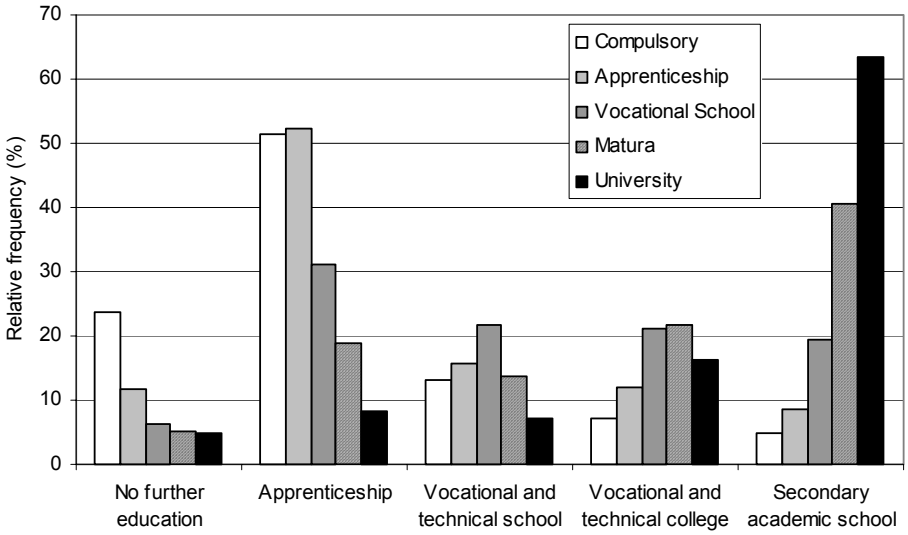
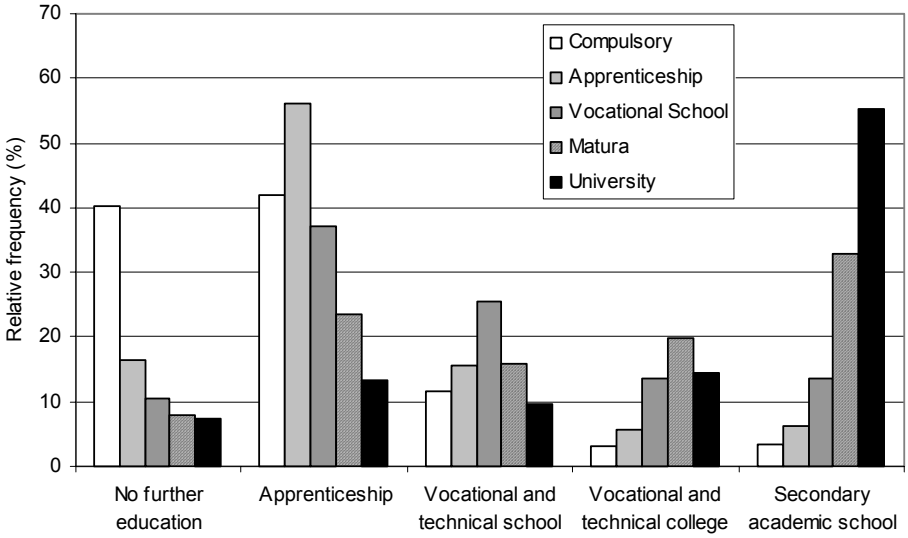


Figure 4.6: Transition rates to secondary education conditional on education of parents for the age cohort 1936-55



5 Effect of Previous Education on Secondary Education

In our previous working paper about compulsory education and the importance of the first educational choice, we investigated the effects of gender, residential area and education of parents at the transition from primary school to lower secondary education (Spielauer et al., 2002). The school forms available at the lower secondary education level are lower secondary school or 'Hauptschule', and lower secondary academic school, that is the lower level of 'AHS'. The results of this paper indicate that the choice between these two school forms strongly depends on the education of parents and the residential area (rural vs. urban area). Since the current paper can be seen as a continuation of the previous one, the question arises whether the choice of school type at lower secondary education level influences the quality of education at the upper level. Such question will be answered in this and the subsequent sections of our paper, where the transition rates from 'Hauptschule' and 'AHS' respectively, to upper secondary education will be investigated.

5.1 Univariate Effect of Previous Education

First, the transition rates from lower secondary education to the upper level are of interest. As Figure 5.1 shows, the effect of the previous school type is considerable. We may have expected that individuals continue their 'AHS' career, but one is surprised at the low transition rates from 'Hauptschule' to colleges and academic schools. Overall 80% of those whose secondary education was 'AHS' continued in colleges and academic schools, and therefore hold a 'Matura' degree, whereas only 12% of 'Hauptschule'-students have one. On the contrary, over 70% of those with 'Hauptschule' received no further education or did an apprenticeship training. The importance of the first educational choice at the transition from primary school to lower secondary is apparent, since this decision obviously predetermines to a great extent the further educational career.

A comparison of Figure 5.1 and Figure 5.2 reveals only minor changes over time. A noticeable alteration took place for individuals whose lower secondary education was 'Hauptschule'. For this subgroup, the prior proportion of 32% of individuals with no further education fell to 18%. In return, the proportion of apprentices rose from 49% to 56%, and the higher educational categories benefited slightly as well. These might be somewhat surprising as one would expect individuals to increasingly attend upper secondary schools and colleges, and therefore, changes over time must be more severe. But as a reminder, we evaluate individual behavior in dependency on influence factors. Such increases in colleges and academic schools are caused by the progress that more and more individuals attend AHS at their lower educational level.

Figure 5.1: Transition rates from 'Hauptschule' and 'AHS' respectively to secondary education for the age cohort 1956-75

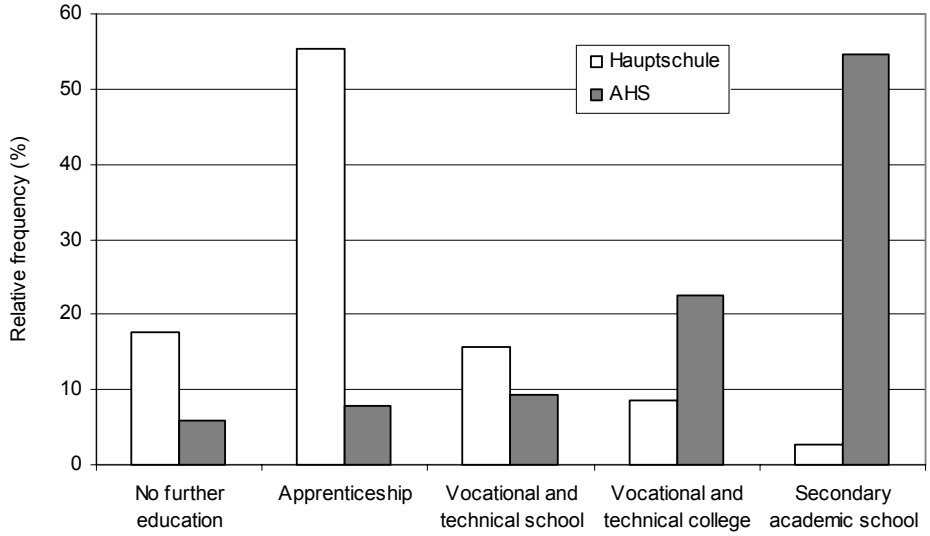
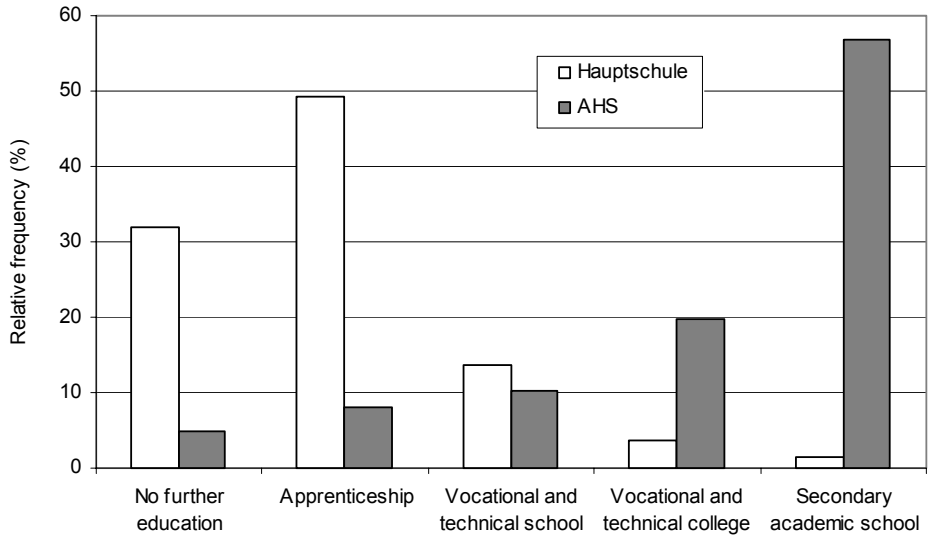


Figure 5.2: Transition rates from 'Hauptschule' and 'AHS' respectively to secondary education for the age cohort 1936-55



5.2 Multiple Effect of Previous Education in Conjunction with Residential Area

After investigating simple effects on upper secondary education, we are interested in studying the influence of previous lower secondary education in conjunction with the remaining factors, that is, residential area, education of parents and gender. Since the univariate analyses already revealed changes over time, we are going to consider multiple effects for the birth years 1956 to 1975, to look into the current educational situation.

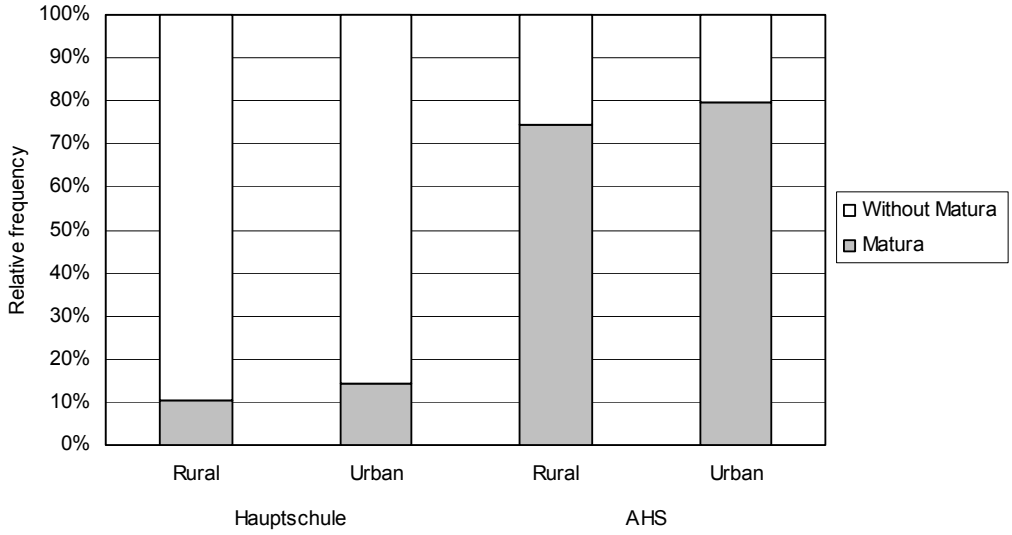
By including the influence of residential area, we examine the assumption that individuals who grew up in rural municipalities predominately transfer from 'Hauptschule' to colleges and academic school, in comparison to individuals of this subgroup from urban areas. This assumption follows a further conjecture, namely that 'Hauptschule' in rural municipalities

have a higher educational standard than in urban areas, since the number of academic schools is limited in rural areas, and consequently, more talented pupils possibly attend 'Hauptschule', for the reason not to commute into remote towns and cities.

Table 5.1. Transition rates from 'Hauptschule' and 'AHS' respectively to secondary education for rural and urban regions (in percent)

		Secondary education				
Lower secondary education	Municipality type	No further education	Apprentice	Voc. and tech. school	Voc. and tech. college	Academic school
'Hauptschule'	Rural (n=6522)	18.5	56.0	15.2	7.9	2.4
	Urban (n=2020)	15.5	53.5	16.7	10.9	3.4
	Total (n=8542)	17.8	55.4	15.6	8.6	2.6
'AHS' (Academic school)	Rural (n=930)	5.3	9.8	10.6	24.3	50.0
	Urban (n=995)	6.2	5.9	8.1	20.6	59.1
	Total (n=1925)	5.8	7.8	9.4	22.4	54.7

Figure 5.3: Transition rates from 'Hauptschule' and 'AHS' to 'Matura' for rural and urban areas



Evidently, this assumption is rejected by statistics, as Table 5.1 shows. For most individuals who attended 'AHS', a superior educational career followed, independent of the individual's place of living. The same applies to individuals from 'Hauptschule', where the educational career is generally limited to apprenticeships and vocational schools. Severe are the transition rates from 'Hauptschule' to *no further education* for rural (18.5%) and urban areas (15.5%). Surprisingly, the transition rates from 'Hauptschule' to colleges and academic schools are a little higher for urban municipalities. This fact may be traced back to the higher number of colleges and academic schools in urban areas and to the preference of apprenticeships in rural areas. In Figure 5.3 the situation is illustrated even more explicitly. While 74% or 80% respectively of those whose lower secondary education was a 'AHS'

received a 'Matura' degree, only 10% or 14% respectively did so, when they were in 'Hauptschule'.

5.3 Multiple Effect of Previous Education in Conjunction with Gender

Subsequently, a look into the effect of previous education in connection with gender is taken. The influence of previous education is the decisive factor again. Though, within the subgroup 'Hauptschule', females tend distinctively more to vocational schools than males[3], and males obliviously prefer apprenticeships. Noticeable is the high proportion of females with no further education when they attend 'Hauptschule' (23.8%). The subgroup 'AHS' shows just minor differences between males and females.

Table 5.2: Transition rates from 'Hauptschule' resp. 'AHS' to secondary education in dependency on gender (in percent)

		Secondary education				
Lower secondary education	Gender	No further education	Apprentice	Voc. and tech. school	Voc. and tech. college	Academic school
'Hauptschule'	Female (n=4443)	23.8	41.0	22.3	9.5	3.3
	Male (n=4498)	11.8	69.6	8.9	7.7	2.0
'AHS' (Academic school)	Female (n=1114)	5.8	6.2	11.5	20.8	55.6
	Male (n=1008)	6.0	9.6	6.8	24.2	53.4

5.4 Multiple Effect of Previous Education in Conjunction with Education of Parents

In Section 4.3 of our paper we have shown the substantial influence of the educational level of parents on the quality of upper secondary education. However, does this circumstance occur because individuals of parents with an advanced education attended predominantly 'AHS' in lower secondary education or do individuals from 'Hauptschule', especially those whose parents received a better education, have a chance for a superior secondary education as well? Do individuals of parents with lower education have a higher change for a better-quality secondary education when they attended 'AHS' before? This questions can be answered by having a look at the transition rates from the lower secondary education level to the upper one and, additionally, by taking the effect of education of parents into account.

[3] This may be caused by the fact that females predominantly attend the 'Handelsschule'.

Table 5.3: Transition rates from 'Hauptschule' and 'AHS' respectively to secondary education in dependency on education of parents (in percent)

		Secondary education				
Lower secondary education	Education of Parents	No further education	Apprentice	Voc. and tech. school	Voc. and tech. college	Academic school
'Hauptschule'	Compulsory (n= 4221)	23.2	56.5	13.2	5.5	1.6
	Apprentice (n=2870)	12.4	59.7	16.0	9.7	2.3
	Voc. school (n=589)	6.6	42.3	27.3	18.3	5.4
	Matura (n=334)	4.8	38.0	24.6	24.0	8.7
	University (n=124)	11.3	21.8	23.4	21.8	21.8
'AHS' (Academic school)	Compulsory (n=369)	9.8	12.5	14.9	23.0	39.8
	Apprentice (n=464)	6.0	10.6	12.9	26.9	43.5
	Voc. school (n=253)	4.7	5.5	9.5	28.1	52.2
	Matura (n=395)	5.1	3.5	5.3	20.3	65.8
	University (n=365)	1.9	3.6	1.9	14.5	78.1

Table 5.3 shows that the transition rates from 'AHS' to the category *academic school* and to *college* are overall very high, slightly influenced by the education of parents, whereas at the transition from 'Hauptschule' only individuals whose parents have a higher education had a real chance to get into academic schools and colleges. The rates at the transition from 'AHS' to colleges and academic schools for individuals whose parents have compulsory education only are unexpectedly high. Around 50% achieved a 'Matura' degree whereas only 7% from the same subgroup did so at the transition from 'Hauptschule'. All in all, the education of parents just moderately influenced the educational choice at the transition from lower to upper secondary education. In most cases the educational career of individuals apparently is decided at the age of ten years, at the transition from primary school to the next educational level, with the choice between 'AHS' and 'Hauptschule'. Though, at that time education of parents plays an important role, definitely, as we revealed in the previous paper .

6 Logistic Regression Analysis at the Transition to Secondary Education

6.1 Logit Estimates

For the education module of the Family Microsimulation model FAMSIM+ the transition rates from one educational level to the next are required. In a recent study, we investigated the transitions from primary school to lower secondary school. Now the educational behavior of individuals of different social background and regional destination at the transition from lower secondary school to secondary education is of interest. In order to investigate these transitions, a multiple logistic regression analysis was used. The logistic regression allows us to estimate the transition probabilities for any combination of the explanatory variables x_i.

In the analysis, we included individuals born between 1956 to 1975, since we were interested in the most current situation but excluded individuals who have not yet finished their secondary education. Additionally, the sample size had to be large enough, in view of the fact that a frequency of zero in a contingency table causes large estimated coefficients and standard errors in a logistic regression analysis.

Prior to the actual analysis a logistic regression with the trend variable *year of birth* was performed to investigate changes from 1956 to 1975. Significant influences occurred at the category *no further education* at the transition from 'AHS' and at the category *vocational and technical college* at the transition from 'Hauptschule'. This detail well be considered in the FAMSIM model. The remaining categories have shown no significant changes.

From a practice perspective, the most difficult aspect for logit models is interpreting the results, especially in a multinomial model. Table 6.1 shows the goodness-of-fit and the logit estimates for the transitions from lower secondary education to secondary education, separately for the transition status from lower secondary academic school (AHS) to secondary education and from lower secondary school (Hauptschule) to secondary education. The Chi-square statistics of the models are highly significant (p-value=0.000), which shows that the relationship between the dependent variable and the model is probably real and not due to sampling fluctuations. The pseudo R^2 of 0.129 or 0.176 respectively are moderate values for the logistic regression; consequently, these variables are moderately good predictors[4]. However, since our interest lies particularly in the estimation of the effect of the x_i on the response probabilities $P(y = 1|x_1, x_2,\ldots x_k)$, the goodness-of-fit is usually not as important as statistical significance of the explanatory variables.

The logit estimates give the information of the partial effect of each variable on the transition probability. We can detect the strong effect of the education of parents at first glance, and the effect of gender is identifiable as well. *Residential area* shows no effect for the transition from 'Hauptschule'. These results are confirmed by the Likelihood Ratio Test, shown in Table 6.2.

[4] For the logistic regression several pseudo R-square were developed, as an equivalent of the usual coefficient of determination. Although, the R^2 of the logistic regression is calculated in a different way than the R^2 in the ordinary linear regression, it can be interpreted to a great extent in the same way.

A negative effect is noticeable of *female* on *apprenticeship* at the transition from 'Hauptschule'. Clearly visible as well is the strong effect at the transition from 'Hauptschule' of parents having compulsory education or apprenticeship on *no further education* and *apprenticeship*. The fact that all coefficients of the variable *education parents* are grater than zero can be traced back to the fact, that individuals whose parents are *university graduates* (the reference category), have the highest chance for *secondary academic school*, which is the reference category for the dependent variable.

Table 6.1: Logit estimates at the transitions to secondary education

Independent variables	Dependent variable: *Secondary education (ref. secondary academic school)* [5]							
	Transition from 'AHS' to secondary education (n = 2 511)				Transition from 'Hauptschule' to secondary education (n = 10 288)			
	no further education	*Apprentice ship*	*vocational and technical school*	*vocational and technical college*	*no further education*	*Apprentice ship*	*vocational and technical school*	*vocational and technical college*
GENDER (ref. male)								
female	-0.301 (0.215)	-0.460* (0.194)	0.427* (0.179)	-0.282* (0.121)	0.121 (0.158)	-1.104** (0.150)	0.383* (0.158)	-0.310 (0.163)
RESIDENTIAL AREA (ref. urban)								
rural	-0.326 (0.223)	0.490* (0.205)	0.119 (0.181)	0.156 (0.125)	0.036 (0.177)	0.024 (0.166)	0.027 (0.173)	-0.087 (0.180)
EDUCATION PARENTS (ref. university)								
compulsory	2.357** (0.437)	1.883** (0.360)	2.575** (0.422)	1.015** (0.210)	3.336** (0.371)	3.680** (0.320)	2.031** (0.314)	1.337** (0.323)
apprentice	1.759** (0.437)	1.715** (0.351)	2.424** (0.412)	1.162** (0.191)	2.352** (0.370)	3.369** (0,317)	1.836** (0.311)	1.499** (0.318)
vocational	1.282** (0.497)	0.869* (0.426)	1.934** (0.444)	0.983** (0.214)	0.867* (0.424)	2.082** (0,350)	1.613** (0.345)	1.286** (0.354)
matura	1.156** (0.448)	0.218 (0.420)	1.182** (0.446)	0.437* (0.200)	0.094 (0.464)	1.478** (0.357)	0.943** (0.355)	1.027** (0.359)
intercept	-3.439	-3.197	-3.939	-1.566	-0.743	0.459	-0.171	0.208
Chi-square	223.667				1382.937			
Pseudo R^2	0.129				0.176			

* statistically significant (p < 0.5)
** statistically significant (p < 0.1)

For a further interpretation of the logit estimates the transformation of the coefficients to the odds ratio would be very helpful. We obtain the odds ratio by taking the exponential of the logistic regression coefficient $\exp(b_{ji})$, which explains the partial effect in the response probability from changing a binary explanatory variable x_i from one to zero, holding all other

[5] The reference category 'secondary academic school' is redundant, hence the parameters are set to 0.

variables fixed. The interpretation of the logit estimates in a multinomial logit model remains problematic, though, we have to consider the reference category as well.

Table 6.2: Likelihood Ratio Tests[6]

	Transition from 'AHS' to secondary education				Transition from 'Hauptschule' to secondary education			
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	349.110	-	-	-	428.59	-	-	-
GENDER	370.44	21.33	4	0.000	1147.40	718.81	4	0.000
RESIDENTIAL AREA	359.40	10.29	4	0.036	430.10	1.52	4	0.824
EDUCATION PARENTS	524.14	175.03	16	0.000	1071.12	642.54	16	0.000

6.2 Transition Probabilities

In the Family Microsimulation FAMSIM we require the transition rates from one status to the next for each individual with a certain characteristic resp. for any combination of the explanatory variables. For a logit model with more than two outcomes the transition probabilities are[7]

$$p_1 = \frac{e^{\text{logit}(p_1)}}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}, \quad p_2 = \frac{e^{\text{logit}(p_2)}}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}, \cdots, \quad p_{l-1} = \frac{e^{\text{logit}(p_{l-1})}}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}, \quad p_l = \frac{1}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}$$

where

$$\text{logit}(p_j) = \sum_{i=1}^{k} b_{ji} \cdot x_i$$

for *k* explanatory variables (resp. categories) and *l* response categories.

The following example will help to understand the mode of calculation. For a female that resided in an urban area and whose parents have an apprenticeship, the logits at the transition from 'Hauptschule' are

[6] The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

[7] For derivation and detailed explication of the logistic regression see appendix.

$$\text{logit}(p_1) = \sum b_{1i} \cdot x_i = -0.743 + 0.121 + 2.352 = 1{,}730$$
$$\text{logit}(p_2) = \sum b_{2i} \cdot x_i = 0.459 - 1.104 + 3.369 = 2.724$$
$$\text{logit}(p_3) = \sum b_{3i} \cdot x_i = -0.171 + 0.383 + 1.836 = 2{,}048$$
$$\text{logit}(p_4) = \sum b_{4i} \cdot x_i = 0.208 - 0.301 + 1.499 = 1.406$$
$$\text{logit}(p_5) = 0$$

The redundant fifth category of the dependent variable works as reference category; consequently the parameters b_{5i} are set to zero. Out of these logits we are able to calculate the transition rates:

$$p_1 = \frac{e^{\text{logit}(p_1)}}{\sum_{j=1}^{5} e^{\text{logit}(p_j)}} = \frac{e^{1.730}}{e^{1.730} + e^{2.724} + e^{2.048} + e^{1.406} + e^{0}} = \frac{5.641}{33.714} = 0.167$$

$p_2 = 0.452$; $p_3 = 0.230$; $p_4 = 0.121$; $p_5 = 0.029$

Table 6.3 and Table 6.4 show the transition probabilities for any combination of the explanatory variables.

Table 6.3: Transition probabilities for the transition from 'AHS' to secondary education

			Secondary education				
Gender	Residence	Education of parents	No further education	Apprentice	Voc. and tech. school	Voc. and tech. college	Academic school
Female	Rural	Compulsory	7.51	11.51	18.34	21.10	41.54
		Apprentice	4.32	10.17	16.50	25.55	43.45
		Voc. school	3.27	5.33	12.32	26.07	53.00
		Matura	3.63	3.49	7.30	18.97	66.61
		University	1.34	3.30	2.63	14.41	78.31
	Urban	Compulsory	11.16	7.55	17.44	19.35	44.51
		Apprentice	6.50	6.76	15.89	23.72	47.13
		Voc. school	4.82	3.47	11.63	23.73	56.35
		Matura	5.21	2.22	6.72	16.83	69.03
		University	1.92	2.09	2.41	12.74	80.84
Male	Rural	Compulsory	9.24	16.60	10.89	25.46	37.82
		Apprentice	5.31	14.64	9.78	30.78	39.49
		Voc. school	4.08	7.78	7.41	31.86	48.87
		Matura	4.58	5.17	4.45	23.52	62.28
		University	1.71	4.92	1.62	18.00	73.75
	Urban	Compulsory	13.89	11.02	10.48	23.62	41.00
		Apprentice	8.10	9.87	9.56	29.01	43.47
		Voc. school	6.07	5.11	7.06	29.28	52.47
		Matura	6.62	3.30	4.12	21.00	64.96
		University	2.47	3.14	1.50	16.05	76.85

Table 6.4: Transition probabilities for the transition from 'Hauptschule' to secondary education

			Secondary education				
Gender	Residence	Education of parents	No further education	Apprentice	Voc. and tech. school	Voc. and tech. college	Academic school
Female	Rural	Compulsory	30.80	41.97	19.06	6.21	1.97
		Apprentice	17.13	45.74	23.35	10.85	2.93
		Voc. school	8.27	26.94	39.82	18.71	6.25
		Matura	6.40	24.70	34.21	24.21	10.48
		University	13.27	12.82	30.31	19.74	23.86
	Urban	Compulsory	30.33	41.82	18.94	6.91	2.01
		Apprentice	16.75	45.25	23.03	12.00	2.97
		Voc. school	8.01	26.38	38.89	20.46	6.27
		Matura	6.15	23.99	33.15	26.28	10.43
		University	12.78	12.49	29.45	21.48	23.80
Male	Rural	Compulsory	15.40	71.39	7.33	4.77	1.11
		Apprentice	8.13	73.85	8.52	7.93	1.57
		Voc. school	4.97	55.08	18.40	17.30	4.24
		Matura	3.86	50.67	15.86	22.47	7.13
		University	9.65	31.73	16.95	22.09	19.58
	Urban	Compulsory	15.16	71.11	7.28	5.31	1.13
		Apprentice	7.97	73.23	8.43	8.78	1.59
		Voc. school	4.82	53.99	17.99	18.95	4.25
		Matura	3.72	49.33	15.40	24.44	7.11
		University	9.27	30.83	16.43	23.99	19.49

The results cover the conclusions of the previous sections. It is noticeable that the transition rates are on the whole very high from the lower academic school to the next level of academic school and to colleges, which is barely influenced by the educational level of parents, gender and residential area, whereas at the transition from 'Hauptschule' to secondary education only individuals whose parents have higher educational level had a real chance to get into academic schools and colleges.

7 Summary

The ability to identify individuals at the micro level at the transition from lower to upper secondary education permitted us to investigate influence factors such as gender, residential area, education of parents and previous education at this particular transition point. Gender, residential area and education of parents just moderately influence the educational choice. Certainly, individuals of parents with higher education have a better chance for a superior education, especially when they grow up in urban regions, but in most cases the educational career apparently is decided at the transition from elementary school to the next educational level, with the choice between 'AHS' and 'Hauptschule': If an individual attends an 'AHS' at the lower secondary education level, he/she will have a much higher change of a superior secondary education than an individual who attends 'Hauptschule'. This fact is in line with the results from our previous paper about the transition from elementary school to lower secondary education, where we showed that whether an individual attends an academic school strongly depends on the education of parents and the residential area. Accordingly, in most cases the decision for a superior upper secondary education (which leads to universities and academies) is taken at the age of ten when individuals enter lower secondary education.

As a next exciting step these outcomes will be implanted in the Education Module of the Family Microsimulation Model FAMISM+, which enables us to simulate educational development into the future.

8 Comment[8]

The results of the two working papers indicate that social selection processes play an important role in the Austrian educational system. Although a clear trend to inclusion (meaning continuously raising participation rates of young people who are enrolled in post-obligatory education – a development described with the term educational expansion) can be observed over the past decades, the system as a whole tends to be reproductive to a high degree with respect to the unequal access of different social groups to the different forms of schools. As Lassnigg (2000) stressed, the question about realization of equal opportunity or access to education, respectively the reproduction of social inequality, has so far not been the focus of research in Austria. Only few and indirect information is available . Our studies also try to break some ground in these specific research field.

As we have shown, access to higher further education in Austria is still subject to pronounced social selection processes. The probability that young people with a higher educational background (of the parents) choose higher forms of schools tends to be very stable over time on the individual level. It is the slowly raising attendance rates into lower academic secondary schools of children of parents with vocational or just compulsory education that, over time, fuelled the educational expansion. In some sense, the gap seems to be widening, especially if one regards the rural-urban differences in school-choices. The

[8] Comment by Kurt Schmid, ibw - Institut für Bildungsforschung der Wirtschaft, Vienna.

distinct feature of the Austrian educational system - the early differentiation in the two forms of lower secondary education (Hauptschule versus AHS) – can be regarded as the backbone of this social selection process: Our studies indicate that the social parental background variable (in the form of the educational level of the parents) has its main influence at this transition point. Therefore children are overwhelmingly not selected into one of the two forms of lower secondary education according to their intellectual capacity at that point of time (however this will be an appropriate selection criteria for their future possible intellectual evolvement). It is the parental background (the combination of their educational level and the residential area) that essentially rules the school-choices. Generally, these school-choices are later (i.e. on grade 8 or 9) not reversed.

Why are these transitions so stable on an individual level, especially with respect to social groups? A possible answer to this question can be derived from Bourdieu. According to him, it is the vertical structure of objective educational chances that influences the practical, i.e. daily, experience of people. Accordingly, social groups differ in their prospective "self-assessment" of reaching a certain educational level in the future as "unreachable", "possible" and "normal".[9] And this in turn guides the actual school-choices (Bourdieu and Passeron, 1971). Therefore formal equality of access to education cannot overrule the unequal starting-conditions and positions of social groups. In that sense equality reproduces inequality (Bourdieu, 1992).

Unfortunately, these aspects seem to loose grounds in the public debate about school-reform. The meaning of the term equality of educational chances has shifted away from its former impetus of upgrading the disadvantaged or underprivileged groups to the advancement of the individual. In short: From social emancipation to individual competitiveness. Contrary to the controversial findings of Hradil (1994), who sees for Germany a process of pluralisation of modes of life that lead, according to him, to a partial decoupling of 'subjective' life-formation and 'objective' living-conditions, our results stress the ongoing reproductive tendency of the Austrian educational system.

Besides this social selection processes into the vertical educational system, a second aspect of social selection has to be mentioned: The one along the horizontal dimension (meaning into schools of the same school-type that are perceived as better or worse). This aspect is well established in the international literature[10] but generally (again) not well researched in Austria. Especially the high enrolment rates in lower secondary schools (AHS) in urban areas would be an interesting field for future research.

The results of our studies (hopefully) mark a first approximation to the complex topic of the reproductive aspects of the Austrian education systems respectively the educational expansion that has taken place over the last 40 years. The inclusion of the educational module into FAMSIM+ will enable us to study that theme extensively. Moreover, the understanding of these past trends also plays a fundamental role for the prognostic validity of the microsimulation project.

[9] See more on this topic in Bourdieu (2001)

[10] for an early study see e.g. Wiese (1996)

Appendix

Logistic Regression for Binary and Multiple Outcomes

The (ordinary) linear regression enables us to predict the value of a continuous variable in relation to one or several explanatory variables. However, in some studies, the dependent variable is an indicator for the presence or absence of a condition which can be coded 0 or 1, such as employed/unemployed, success/failure or simply yes/no. In this binary response models we are interested in the probability

$$P(y = 1 | x_1, x_2, ..., x_k)$$

For instance, y can be an employment indicator, and **x** denotes i.e. gender, martial status, education, and recent participation in a job-training program. The principle of the logistic regression is the similar to the ordinary multiple linear regression. Though, instead of predicting a value we are able to predict the proportion *p* of individuals with certain characteristics, or the probability of a subject having certain characteristics respectively. To ensure that the response probabilities are strictly between zero and one, we need a function *G* where

$$P(y = 1 | x_1, x_2, ..., x_k) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k)$$

where $0 < G(z) < 1$ for all real numbers of *z*.

For a binary outcome variable, coded 0 or 1, $P(y = 1)$ is estimated by the proportion of 1's in the sample. If *p* describes the proportion of individuals with a certain characteristic, then $(1 - p)$ is the proportion of individuals who do not have this characteristic. The **odds** $p/(1 - p)$ relate these two proportions, and describe the chance. If, for instance, 80% of patients with a certain disease can be cured, then the chance for success is 0.8/0.2 or 4 to 1. In the logit model one estimates rather a transformation of *p* than *p* itself. If we define *z* as the logit of the probability that an individual will have a certain characteristic, we obtain the **logit transformation** or **log odds**

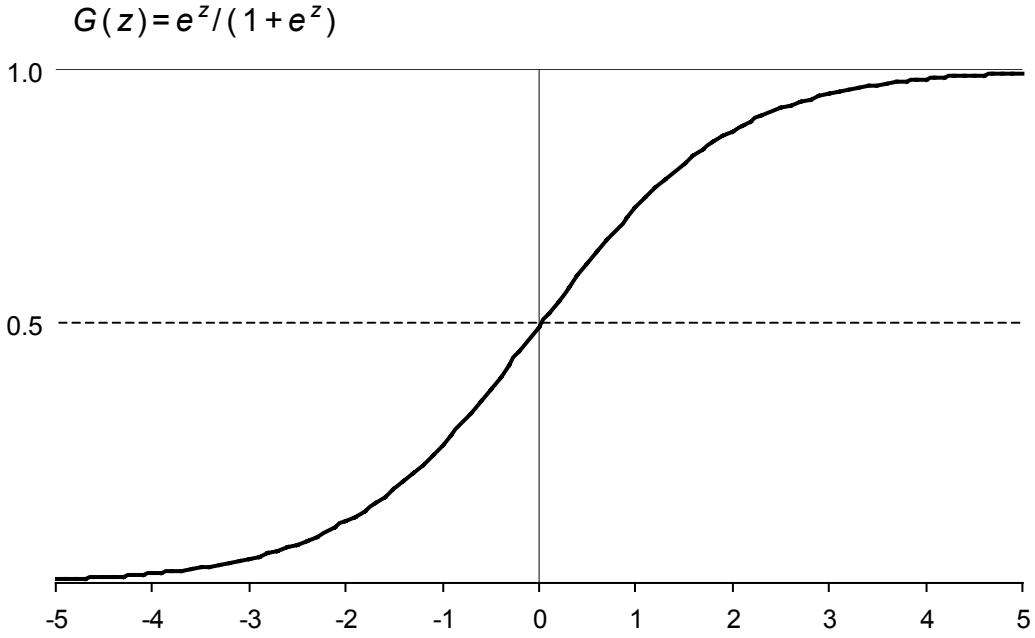
$$z = \text{logit}(p) = \ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k .$$

Taking the exponential of the logit transformation and solving for *p* presents us the **logistic function**

$$p = \frac{e^{\text{logit}(p)}}{1 + e^{\text{logit}(p)}} = G(z) ,$$

whereby $G(z)$ varies always between zero and one for all real numbers of *z*, since $e^z > 0$. The logistic function is shown in Figure A.1.

Figure A.1: Logistic Function



The approach for multiple outcomes is equivalent: For the l categories of the response variable a binary logistic regression of the $l - 1$ non redundant categories takes place. Thus we obtain the equations

$$\text{logit}(p_1) = \sum_{i=1}^{k} \beta_{ji} \cdot x_i$$

$$\text{logit}(p_2) = \sum_{i=1}^{k} \beta_{2i} \cdot x_i$$

$$\vdots$$

$$\text{logit}(p_{l-1}) = \sum_{i=1}^{k} \beta_{l-1,i} \cdot x_i$$

$$\text{logit}(p_l) = 0$$

For the calculation of the logit estimates β_{ji}, $j = 0 \ldots l$, i = 1…k, the redundant l^{th} category works as reference category; consequently the parameters β_{l0}, β_{l1}, … β_{lk} are set to 0. In the interpretation of the logit estimates, we have to consider this circumstance, since the logit estimates explain the effect of a variable x_i on a category y_j versus the reference category y_l. The transition probabilities of the l^{th} category can be calculated out of the remaining $l - 1$ categories. Thus the transition probabilities for k explanatory variables and l outcomes are

$$p_1 = \frac{e^{\text{logit}(p_1)}}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}, \quad p_2 = \frac{e^{\text{logit}(p_2)}}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}, \cdots, \quad p_l = \frac{1}{\sum_{j=1}^{l} e^{\text{logit}(p_j)}}$$

where

$$\text{logit}(p_j) = \sum_{i=1}^{k} \beta_{ji} \cdot x_i \ .$$

In most applications of a binary response model, it is essential to explain the effects of the x_i on the response probability $P(y=1|\mathbf{x})$. Here, the ratio of the odds

$$\frac{P(y=1|x_i=1)/P(y=0|x_i=1)}{P(y=1|x_i=0)/P(y=0|x_i=0)} = \frac{p_1/(1-p_1)}{p_0/(1-p_0)} = \psi ,$$

called the **odds ratio,** can be a very helpful tool. The odds ratio is usually used for comparison of the proportions in two groups. The logarithm of the odds ratio gives us

$$\ln(\psi) = \ln\left(\frac{p_1/(1-p_1)}{p_0/(1-p_0)}\right) = \ln\left(p_1/(1-p_1)\right) - \ln\left(p_0/(1-p_0)\right) = \text{logit}(p_1) - \text{logit}(p_0)$$
$$= z_1 - z_0 = \beta_0 + \beta_1 x_1 + \ldots + \beta_i \cdot 1 + \ldots + \beta_k x_k - (\beta_0 + \beta_1 x_1 + \ldots + \beta_i \cdot 0 + \ldots + \beta_k x_k) = \beta_i .$$

If we take the exponential of the logistic regression coefficient, we obtain the odds ratio,

$$e^{\beta_i} = \psi = \frac{P(y=1|x_i=1)/P(y=0|x_i=1)}{P(y=1|x_i=0)/P(y=0|x_i=0)},$$

which simply explains the partial effect from changing a binary explanatory variable x_i from one to zero, holding all other variables fixed.

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