Does Proximity of Schools Matter? Choice Behavior of High School Leavers Concerning Academic or Professional Training

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Abstract

Several studies are concerned with the choice behavior of high school leavers. Researchers consider increasingly broader sets of choices within a multinomial choice framework by including transitions to work and to other levels of education. The present paper follows from this literature and identifies the factors behind individual decision-making in the transition from high school to post-secondary education in The Netherlands.

Given the binary structure of the Dutch higher education system high school leavers follow a hierarchical decision-making process. Initially, they decide whether they want to continue education. Subsequently, the subset that wants to continue education has to make a choice between professional college and the university. We address the determinants of both types of decision in the current paper. Particular attention is given to accessibility aspects, including the geographic location of higher education institutions. The main hypothesis is that individuals who live in closer proximity to a higher education institution are more likely to continue studying after high school, and they are more likely to choose that type of institution.

In order to test these hypotheses, we apply mixed discrete choice models to individual-level data on post-secondary education choices. Several institutional characteristics are considered together with variables controlling for the student's socio-economic background and residential location.

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1 Introduction

The pattern of transition from school to the labor market has been changing. Models of educational investment decision, which assume that an individual goes through a period of full-time education followed by a period of full-time employment, can only partly explain nowadays reality. The transition from school to work is becoming a gradual process, as individuals are periodically deciding whether to continue on the educational system, and whether to participate in the labor market.

The timing of the decision on whether to continue studying has also been shifting. Several studies have analyzed the choices made by school leavers at the end of compulsory schooling (see, for instance, Rice, 1999), since this is the first point in time in which youngsters opt between staying on or leaving the school. More recently, the end of secondary school has become an important decision moment. On one hand, this results from the fact that individuals tend to spend more and more time at school and the number of students who conclude secondary education is rising (OECD, 1997: 319). Completing the upper secondary education has becoming a minimum requisite not only to access the tertiary education level, but also to participate in labor markets that are more and more demanding on skills (OECD, 1997: 319). On the other hand, studies on wage inequality have highlighted the rising difference between the earnings of those who get a university degree and the earnings of those who just finish the secondary school (see, for instance, Taber, 2001; Chen, 2003). Some studies go even further in returns to schooling analysis, by comparing returns between different higher education tracks, that is, academic versus vocational tracks. Heijke and Koeslag (1999) conclude that university studies generate more human capital, which cause university graduates to earn more than graduates of higher vocational education, regardless the occupational domain in which they work. Margolis and Simonnet (2003) find support for the hypothesis that technical/professional education provides individuals with higher quality networks of contacts than general education, which seem to be the best way to do well in labor market, either being faster in finding a job, or providing better wages.

High school leavers' decisions on whether to continue studying and on whether to work have been analyzed according to a wide variety of standpoints. First studies consider that these are binary decisions, with students choosing between continuing at school and entering the labor market (see, for instance, Kohn *et al.*, 1976). More recent works have considered broader sets of choices, including vocational education options and labor market alternatives, which are analyzed within multinomial models (see, for instance, Riphahn, 2002; Nguyen and Taylor, 2003; Giannelli and Monfardini, 2003). In particular, multinomial models allow for the detection of effects, which are not identifiable in the context of a binary model. For example, Nguyen and Taylor (2003) conclude that students' academic ability has a much greater impact on enrollment in public 4-year college than on enrollment in private 4-year college; the probability of enrollment in each one of those types of education is differently affected depending on the ethnic group and on parental education. Almost always those choices are assumed as independent, and not so many studies take into account either the (potential) dependence of these decisions and/or other choices that youngsters make at the same time. Martinez-Granado and Ruiz-Castillo (2002) work is one of the few papers, which analyzes simultaneously three correlated

decisions: whether to work, whether to study and whether to live in parental house.

Most of recent studies emphasize the effect of local labor markets and regional aspects on youngsters' decisions. However, none of these studies have completely explored the spatial dimension of this decision process. First, although several studies introduce controls for spatial heterogeneity, which in general are local labor-market-related variables, none of them has taken into account the spatial effects that are also at work, namely spatial heterogeneity and spatial auto-correlation. These studies assume that the regional environment of the parental household is the main source for expected earnings and expected employability consequences of schooling, arguing that it is quite unlikely that educational decisions are dominated by expectations relating to the region where the student might possibly work after graduation (Hartog and Serrano, 2002). This regional, aggregate information is then combined with individual data, but ignoring the fact that the disturbances may be correlated across each spatial unit (that is, region or state), which leads to a bias in OLS standard error estimates. According to Moulton (1990), it is reasonable to expect that observations that share an observational characteristic like location, also share unobservable characteristics, implying that disturbances are correlated. Second, a country is a network of regions/states, and what happens in one local labor market may affect what is going on in all of the others. Spatial autocorelation is expected to be the norm in analysis involving space, since elementary units within the same aggregate unit are likely to be similar in ways not taken into account by observed characteristics of both the elementary and aggregate units. When ignored, spatial autocorrelation results in mis-estimated standard errors in linear models, and (in addition) inconsistent parameter estimates in non-linear models. Riphahn (2002) use a non-parametric random effects estimator, proposed by Heckman and Singer, to address the first problem, but the second one remains unsolved. Furthermore, previous papers ignore the multilevel structure of the data, which is another potential for the results to be misleading.

This study addresses these important spatial issues based on individual data for The Netherlands. We focus on high school leavers' decisions made by Dutch students who have a high school diploma. We have identified three spatial scales that are relevant to the study of their choice behavior: individual, school and municipality. Since individuals are nested within schools, which are in turn nested within municipalities, multi-level models appropriately describe school and municipality effects. The model formulation takes the form of a mixed logit structure, for high school leavers' choice among three alternatives: vocational college, university and no higher education. The present study therefore adds to the previous literature on this topic along the spatial heterogeneity and correlation effects, which are explicitly modeled.

This paper unfolds as follows. Section 2 provides some background information on the Dutch educational system. The state of art of the literature on the choice behavior of high school leavers is presented in the section 3. Sections 4 and 5 present the empirical model and the interpretation of the estimation results, respectively. Finally, some conclusions of the study are presented in section 6.

2 Dutch educational system: some background

Dutch pupils are admitted to secondary school after leaving primary education, at an average age of 12, and they have to be at school until the age of 16. They are free to attend the school of their choice, provided they meet certain general conditions. In practice, at the end of primary schooling, pupils receive a school report (*onderwijskundig rapport*) describing their level of attainment and potential, which is based on the results of an attainment test (CITO test) and the educational performance, interests and motivation of the child. Based upon that report, primary schools advise parents as to the type of secondary education most suited to their child.

In school year 2000/2001, a total number of about 863 thousand students were distributed over the existent 834 secondary schools (Ministerie van Onderwijs, Cultuur en Wetenschappen, 2003). Secondary education comprises schools providing practical training (PRO, *Praktijkonderwijs*), pre-vocational secondary education (VMBO, *Voorbereidend Middelbaar Beroepsonderwijs*), senior general secondary education (HAVO, *Hoger Algemeen Voorbereidend Onderwijs*), and pre-university education VWO (*Voorbereidend Wetenschappelijk Onderwijs*).

PRO is a special form of secondary education, that aims at preparing students, who are not expected to take a VMBO diploma, for direct entry to labor market, in particular for low-skill jobs. VMBO lasts four years, and aims at providing basis for further vocational education. The HAVO track takes five years, with a first stage of three years followed by a two-year second stage, and prepares students to proceed with their higher education at professional colleges. The longest track, VWO, takes six years, divided into two stages of three years each; it prepares students to go to university, but they are also qualified to study at professional colleges. Either in HAVO or in VWO, the second stage corresponds to upper secondary education. In both HAVO and VWO students have to choose one out of four subject combinations, known as profiles: science and technology, science and health care, economics and society, and culture and society.

There are schools that provide only one type of secondary education, but most secondary teaching takes place within combined schools. In 2000, the denominational structure of the schools show that about 28% are publicly run, while 29% are Catholic and 22% are Protestant; private non-denominated schools represent 11% of the total number and the remaining 9% schools are interdenominational (Ministerie van Onderwijs, Cultuur en Wetenschappen, 2003: 51). All schools have a legal authority (school board). The municipal authorities are the local authority, in both publicly and privately run schools. Provincial authorities also play a role in the educational system, but with limited action in terms of the management of schools and the curriculum. All regulations and legislation are of responsibility of the central government, in the person of the Minister of Education, Culture and Science.

At the end of secondary education, a certificate is awarded to students who successfully complete this level of education. Students have to do an internal and also national exam in order to get this certificate, which is a minimum admission requirement for tertiary education. For MAVO, HAVO and VWO students the transfer rates for post-secondary education is higher than 90% (Ministerie van Onderwijs, Cultuur en Wetenschappen, 2003: 48). In 2000, about 72% of those students graduating from HAVO went to professional

higher education; among those finishing VWO, also 27% went to professional education, but universities took the biggest share, with 65% going to university education (Ministerie van Onderwijs, Cultuur en Wetenschappen, 2003: 49). Transferences between HAVO and VWO may also happen.

The last level of education one can achieve is the tertiary education or higher education level. The Dutch higher education system, is a dual system, with universities (WO, *Wetenschappelijk Onderwijs*) and vocational colleges (HBO, *Hoger Beroepsonderwijs*), almost all entirely publicly funded. The Netherlands has thirteen universities, including three technical universities and one agricultural university. About 167 thousand students attended these institutions, in 2002/2003. In 2000, there were 56 HBO institutions. Following a higher vocational education is more and more common among Dutch high school leavers. Among the 324 thousand in the sector in 2002/2003, about 82 thousand were first-year students; a share of 37% have a HAVO diploma, while only 8% of those who followed VWO in high school go to vocational higher education (CBS, 2003).

Every school year, government sets some minimum requirements regarding the secondary school diplomas that allow students to apply for each course. Institutions can impose requisites regarding subjects' choice. The most frequent is the obligation of studying some specific subjects during secondary education in order to access to a certain course. In general, all students with a secondary school diploma may have access to university education, although some exceptions apply. But, for most of the programs, there are no supply constraints and there is no need of studying demand and supply simultaneously. The same is not entirely true for professional colleges, which benefit from some more freedom regarding the admission criteria definition, implying that demand and supply have to be studied at the same time.

Students have to pay fees; its amount is equal across all students and not very high. All regular full time students are eligible for student support provided by the government, which is compatible with some part time jobs. All students are eligible for a basic grant for the nominal duration of the higher education program (4/5 years), and its amount depends on whether student lives in parental home. Depending on their income, students can also apply for additional funding, namely a supplementary grant or even a loan. Since 1990, all students receive a transportation pass, allowing them to travel for free during workdays, and with discount on weekends. Until the 70s, a policy of decentralization of higher education based on the establishment of new universities was implemented in The Netherlands. This was guided mainly by spatial equity reasons. As a result of this process, average accessibility of the university system is now relatively high (Florax *et al.*, 2001: 26).[1]

In such a context of cheap and easy access to higher education, what does determine Dutch high school leavers' decision on whether to continue studying? What is behind their choice between university and professional college?

[1] There is a density of about three universities per 10.000 km^2, although there is considerable variation between regions.

3 Literature on choice behavior of high school leavers

There are several branches of literature on high school leavers' choices, from which the present work follows. A big group of studies analyses the decisions of whether to work and whether to study beyond the secondary level. Other studies establish the link between these choices and other youngsters' decisions, such as the household formation decision and the choice of a residence. We concentrate on the decision taken at the end of secondary school, given the increasing relevance that this moment has been achieving in the decision to continue studying.

Earlier empirical studies assume the choice behavior of high school leavers as a binary decision between further education and labor market. Whether the individual pursues a post secondary education or not is the research question in a huge number studies, which model it using logit/probit specifications (see for instance, Kohn *et al.*, 1976; Bishop, 1977; Venti and Wise, 1983; Kodde, 1986; Catsiapis, 1987; Savoca, 1990; Kjellstrom and Regner, 1998; Black and Sufi, 2002). However, the option by youngsters regarding their continuation at the school system is not confined to the decision to attend college or a non-schooling activity. More recently, new institutions apart from the universities have been given the opportunity to be included at the tertiary (post-secondary) education level. The purpose of almost all these schools is vocational and professional oriented education. The set of choices is not binary any more, suggesting the use of multinomial specifications. The choice set varies between studies, depending on whether the emphasis of the study is on educational choices or on labor market destinations (see, for instance, Fuller *et al.,* 1982; Ordovensky, 1995; Maani, 2000; Black and Sufi, 2002; Riphahn, 2002; Nguyen and Taylor, 2003).

The decisions on whether to continue studying and whether to enter the labor market have been analyzed according to a wide variety of standpoints, but almost always these choices are considered independent of each other. However, some exceptions apply. Sá and Portela (1998) use a bivariate probit model to model the correlated and simultaneously taken decisions on working and studying. Martinez-Granado and Ruiz-Castillo (2002) go further in the analysis on youngsters' decisions, studying their joint decision on whether to remain in parental household, whether to work, and whether to continue at school within a trivariate probit specification. The same three decisions are the main focus of the work by Giannelli and Monfardini (2003), who use a multinomial probit for the analysis.

But, what are the possible reasons behind an individual's decision to go to university or another post-secondary school? The decision to continue in school is, usually, made by those individuals who anticipate higher future returns for a post-secondary degree than for a secondary degree. It is mainly the individual's will of investing in human capital that makes the youth go on studying. In the context of the human capital theory, education can be viewed as an investment good (Kodde and Ritzen, 1988; Demeulesteer and Rochat, 2000). In fact, students spend money and time in school because they expect to raise their productivity and, consequently, their future wages. Apart from being an investment decision, the demand for education could also be a current consumption choice (Kodde and Ritzen, 1988; Duchesne and Nonnemann, 1998). People may attend college because they like the courses or the student life-style. Theories that consider schooling as a consumption activity stand that demand for higher education varies positively with students' income

and negatively with its costs, which can be either direct (tuition) or indirect (opportunity) costs. Kodde and Ritzen (1984) integrate consumption and investment motives in a unique model, according to which students choose the optimal level of education, current and future consumption, subject to time and budget constraints. The solution for this problem suggests that individual's demand for education is a function of direct and indirect costs, income and wage differentials.

The direct (opportunity) cost of attending a higher education institution has received quite a lot of attention in empirical work (see, for instance, Ordovensky, 1995). Direct costs include tuition, books and fees; food and housing are not always opportunity costs because these exist in any case. It has been found that human capital investments are more likely when costs are lower (Bishop, 1977; Fuller *et al.*, 1982). Studies that analyze the effect of having a college in students' hometown on college going decisions find that this effect is larger for those students who would otherwise stop schooling at low levels (Card, 1993). Financial support packages, covering at least partly the expenses of college education, are available in most of higher education systems. The amount of financial aid, in the form of grants and scholarships, is expected to have a positive effect on the probability of enrollment (Fuller *et al.,* 1982; Catsiapis, 1987). Nevertheless, these financial aid packages rarely cover all the out-of-pocket expenses, such that students are quite often dependent on their families' financial resources.

Household income is among the most commonly evoked arguments when discussing the decision to continue studying after secondary level, with most of the studies finding that the higher the income of the household, the higher the demand for post-secondary education and the propensity to be at school after the secondary level (Kodde, 1986; Kodde and Ritzen, 1988; Savoca, 1990; Duchesne and Nonnemann, 1998; Checchi, 2000; Hartog and Serrano, 2002). In particular, higher income students are more likely to attend a four-year college, in the US (Nguyen and Taylor, 2003). Parental educational level and occupational status are sometimes used either to proxy this income effect, or to capture its own impact, and exert a positive influence on youngsters' decisions to attend higher education (Kohn *et al.,* 1976; Venti and Wise, 1983; Kodde, 1986; Kodde and Ritzen, 1988; Savoca, 1990; Kjellström and Regnér, 1998; Checchi, 2000; Hartog and Serrano, 2002). In particular, as parental qualifications improve, the probability of enrolling in a four-year college increases and the probability of taking a job and leaving school decreases (Nguyen and Taylor, 2003). Nguyen and Taylor (2003) conclude in favor of a positive effect of parental occupation as well.

Average earnings differential between higher education graduates and high school graduates is a good indicator of relative labor market conditions. Empirical studies have found a positive effect of the wage differentials between college and non-college occupations in local labor market on students' likelihood to attend post-secondary education (Bishop, 1977; Kodde, 1988; Duchesne and Nonnemann, 1998; Hartog and Serrano, 2002). Furthermore, individuals have to assess their probabilities of success in specific fields and/or occupations. The expected future unemployment, reducing the returns to education, could reduce the demand for it (Ordovensky, 1995; Riphahn, 2002). Current unemployment rate also plays a role in this decision process, with poor employment prospects retaining youngsters in school (Corman and Davidson, 1984; Savoca, 1990; Hartog and Serrano, 2002; Giannelli and Monfardini, 2003). Some recent works are devoted to the

effect of family, of neighborhood and of ethnicity on individuals' human capital decisions, probably because the knowledge of others' behavior reduce the uncertainty involved in this type of decisions (Borjas, 1995).

Human capital theory also predicts that present-oriented people are less likely to go to college than forward-looking people (other things equal), and that most college students are young (Ehrenberg and Smith, 2000). The present-orientedness is quite difficult to test, but age has been included in most of empirical studies.

Kodde and Ritzen (1988) add to the consumption and human capital explanations a third one, which comes from the screening theories. From the individual standpoint, the screening approach is quite related to the human capital theory. While human capital theory says that education increases individual human capital, screening theory stands that education selects more able students, who are assumed to be more productive, which is subsequently useful information for employers (that is, a filter argument). According to the latter, at each level of education students select themselves to go to the next educational level on the basis of their own scholastic ability, which may be related with their productivity. In this context, it becomes quite relevant to take into account the students' ability; and more talented students are expected to have a higher probability of demanding for higher education. Test scores have been used as a proxy for the individual initial stock of human capital, and students with higher scores seem to be more likely to attend post-secondary education (Fuller *et al., 1982;* Venti and Wise, 1983; Kodde, 1986; Catsiapis, 1987; Savoca, 1990; Kjellström and Regnér, 1998; Maani, 2000), namely they are more likely to opt for academic programs (Ordovensky, 1995; Nguyen and Taylor, 2003).

Previous empirical works also find other individual/family and school characteristics to be relevant. Gender seems to play a role in college going process, but the results are not consistent between studies. Some studies conclude for a higher probability of going to college for female students (Kodde, 1986; Kodde and Ritzen, 1988; Savoca, 1990), namely young girls are more likely to choose a two-year college academic program or no post-high school enrollment (Ordovensky, 1995). Other studies conclude that this probability is higher for male youngsters (Catsiapis, 1987). Checchi (2000) finds no evidence of gender discrimination in the probability of attending university. According to most of the studies, black youth are more likely to go to college than white ones (Venti and Wise, 1983; Catsiapis, 1987; Rice, 1999; Nguyen and Taylor, 2003). Fuller *et al.* (1982) and Savoca (1990), however, find exactly the opposite. Riphahn (2002) concludes that being of a foreign origin increases the probability of non-employment. Also parental nationality seems to be relevant to youth choices. Family structure appears to be another determinant of youngsters' decisions (Nguyen and Taylor, 2003). The higher the number of siblings and/or the family size, the lower the probability of attending college (Bishop, 1977; Hartog and Serrano, 2002). Those students who have siblings in college are more likely to attend it, as well (Catsiapis, 1987).

The type of secondary school of origin may determine how likely the student is to enroll in higher education (Catsiapis, 1987; Kodde and Ritzen, 1988; Checchi, 2000; Nguyen and Taylor, 2003). The direction of the effect, however, varies between countries and with the structure of the educational system. School location (related) effects are also taken into account in some studies. Namely the social status of the neighborhood

where the high school is located has a positive effect on youngsters' attendance of higher education institutions (Bishop, 1977). The educational track and peer's plans appear to have a positive effect as well (see for instance, Fuller *et al.,* 1982; Ordovensky, 1995; Maani, 2000). The higher the admission standard, the lower the probability of attending college (Bishop, 1977). Savoca (1990) shows that the effect of the academic quality of the institution on youngsters' application decision is quite small and statistically insignificant.

It has been shown that student's region of residence and/or the urbanization level of the living place play a role in determining youngsters' decisions (Riphahn, 2002; Giannelli and Monfardini, 2003; Nguyen and Taylor, 2003). Living in small villages makes individuals less likely to study and less likely to work (Martinez-Granado and Ruiz-Castillo, 2002). Most studies find a negative distance effect (see for instance, Fuller *et al.*, 1982; Ordovensky's, 1995). Kjellström and Regnér's (1998) results, however, indicate that in Sweden geographical distance to the nearest university did not influence the educational decisions of individuals born in 1948 and 1953.

The topic of youth residential choice, one of the determinants included in studies on working and studying decisions presented above, have been under analysis by itself in several studies. Kohn *et al.* (1976), in one of the earliest studies on students residential choice, find that income play a role in what concerns the residence choice of young students. The probability of campus residency increases with distance and at each distance the probability is higher for higher income students. Ono (2001) analyses migration among Japanese students, using a logit model. The main conclusion is that most of the university resources as well as the high-quality institutions are concentrated in large cities, and students move away from regions with low university resources to those with higher resources. McCann and Sheppard (2001) consider migration to attend university as a first step in a sequential migration decision process, in which the next interrelated step is the decision to migrate to an employment location. They show that for the initial decision to move, better higher education institutions induce more migration, high intra-regional availability of higher education reduces migration, and men are in general more mobile than women. In two related papers (McCann and Sheppard, 2002a,b) they further investigate the relevance of cultural and institutional factors, and of gender.

To summarize, many studies on school leavers choice behavior recognize the potential importance of a wide range of regional factors in influencing students behavior. Ignoring the spatial context in which individuals make their choice can lead to wrong either evaluation or formulation of education policy measures. Furthermore, most educational data have a hierarchical structure with students nested within schools, and schools nested within bigger spatial units. In such a spatial clustering context, it is important to recognize the existence of spatial autocorrelation and spatial heterogeneity. In order to take into account this clustering of the data in the analysis of school leavers' choices, we propose the use of a mixed logit model, within the context of a multi-level analysis framework. The model, its estimation and the available data are presented and discussed in the next section.

4 Empirical framework

4.1 Empirical model and estimation procedures

Analytical methods have not been used, that assess the relevance of both students' characteristics and the characteristics of their milieu, considering them independent of their attributes and of their behavior. Clearly, for most individuals there is not a unique place where they live and socialize. It is not only the place where students live, but also the place of the high school they attend, that have an impact on students' decisions.

The fundamental unit of analysis in a study of school leavers' choices is the individual student. As it was described in the previous section, a wide range of individual characteristics have been used in all studies; and student choices are believed to vary according to age, gender, ethnicity, and previous performance.

But students do not live in isolated contexts. They socialize with other individuals, namely those attending the same high school. We can expect that students attending the same school tend to be more alike in their characteristics than individuals randomly chosen from the whole population. Because they were taught together and they keep on socializing in their everyday life, they tend to be similar in their choices, or at least they may develop some common features which predispose them to choose in certain ways. Since studies on school leavers' behavior look at individuals rather than schools, characteristics of the high schools are usually incorporated in the model as individual level aspects.

Much student socialization occurs outside school, in particular spatial contexts. Individuals with the same characteristics in some areas are more likely to choose studying at university than in other areas. Some attention has been paid to the spatial contexts where students socialize, and where they collect information about the labor market consequences of their choices. Again, because most studies of school leavers' choices are based on data randomly collected from the whole population, local/regional variables are treated as individual level characteristics. Nevertheless, there is not a single spatial context where students learn about their choices. From the neighborhood to the province where they live, one can think of several different regional (more and more aggregate) categories to be the unit of analysis for students' local milieu. In The Netherlands, high schools operate under the direction of municipality administration. Furthermore, students tend to study in the same municipality where they live, and data available for the study of school leavers' choice do not include information about the residence place while attending high school. The municipality is, therefore, the natural choice for regional unit of analysis.

Summarizing, we can identify three spatial scales that are relevant for the study of school leavers' choices: individual, school and municipality, such that students are nested within schools, which in turn, are nested in municipalities. In such spatial clustering context, it is important to be aware of two spatial subjects: spatial heterogeneity and spatial auto-correlation. Spatial autocorrelation arises among school leavers within a school and/or a region because of unobserved location factors. Individuals socializing and living close tend to influence each other choices. Ignoring spatial autocorrelation can cause mis-estimated standard errors in linear models, and (in addition) inconsistent parameter estimates in non-linear models (Bhat and Zhao, 2002). Spatial heterogeneity

means variation across spatial contexts. When it is not taken into account in nodeling, spatial heterogeneity can cause structural instability, specially in non-linear models (Bhat and Zhao, 2002).

Our analysis takes into account the hierarchical structure of the real world, by means of multi-level techniques, which also accommodate both spatial heterogeneity and spatial auto-correlation. Two important issues associated with the multi-level analysis are the type of clustering and the functional form of the model structure. Concerning the type of clustering, a three-level model follows from the above discussion. Because we want to study high school leavers' choices, among university, vocational colleges and no higher education, the functional form of the model is of multinomial logit type.

Conventional multinomial logit Consider that associated with each alternative there is an unobserved (latent) utility U^a, with a being the index for the A possible categories of the dependent variable, such that $a = 1, 2, 3$. This utility means the attractiveness of the alternative; the alternative with the highest utility is selected. The response is a choice among alternatives. V^a, $a = 1, 2, 3$, is linear predictor. Then, the utility is modeled as

$$U_i^a = V_i^a + \epsilon_i^a. \tag{1}$$

Alternative f is selected if

$$U_i^f > U_i^g \text{ for all } g \neq f, \tag{2}$$

or, equivalently,

$$U_i^f - U_i^g = V_i^f - V_i^g + \left(\epsilon_i^f - \epsilon_i^a\right) > 0. \tag{3}$$

If the error term ϵ_i^a has an extreme value distribution of type I (Gumbel), then the differences $(\epsilon_i^f - \epsilon_i^a)$ have a logistic distribution, and it follows that the multinomial probability of response category f (the probability that f is chosen) is

$$\Pr(f) = \frac{\exp\left(V_i^f\right)}{\sum_{a=1}^{A} \exp\left(V_i^a\right)}. \tag{4}$$

For individual-specific covariates, a different coefficient vector $\mathbf{g^a}$ is estimated for each alternative except a reference alternative:

$$V_i^a = \mathbf{g}^{a\prime}\mathbf{x}_i. \tag{5}$$

Random coefficient models Now, for alternative-specific covariates, $\mathbf{z}_i^a$, we consider random coefficients β_i, representing individual-specific effects of the covariates:

$$U_i^a = V_i^a + \delta_i^{a(1)} + \epsilon_i^a, \tag{6}$$

$$\delta_i^{a(1)} = \boldsymbol{\beta}_i'\mathbf{z}_i^a, \tag{7}$$

where

$$\beta_i \sim N\left(\mathbf{0}, \Psi_\beta\right). \tag{8}$$

Three-level multinomial logit model (with three-category dependent variable) The general three-level model is

$$U_{ijk}^{a} = V_{ijk}^{a} + \delta_{ijk}^{(1)} + \delta_{ijk}^{(2)} + \delta_{ijk}^{(3)} + \epsilon_{ijk}^{a}. \tag{9}$$

The student level latent variables $\delta_{ijk}^{(1)}$ are composed as

$$\delta_{ijk}^{(1)} = \boldsymbol{\beta}_{ijk}^{(1)\prime}\mathbf{z}_{ijk}^{a(1)} + \boldsymbol{\lambda}^{a(1)}\boldsymbol{\eta}_{ijk}^{(1)}; \tag{10}$$

the school specific latent variables $\delta_{ijk}^{(2)}$ are composed as

$$\delta_{ijk}^{(2)} = \boldsymbol{\beta}_{jk}^{(2)\prime}\mathbf{z}_{ijk}^{a(2)} + \boldsymbol{\gamma}_{jk}^{a(2)\prime}\mathbf{z}_{ijk} + \boldsymbol{\lambda}^{a(2)}\boldsymbol{\eta}_{jk}^{(2)}, \tag{11}$$

where $\boldsymbol{\beta}_{jk}^{(2)}$ are school level random coefficients for alternative-specific covariates $\mathbf{z}_{ijk}^{a(2)}$, $\boldsymbol{\gamma}_{jk}^{a(2)}$ are school level alternative-specific random coefficients for student-specific covariates $\mathbf{z}_{ijk}$, and factors $\boldsymbol{\lambda}^{a(2)}\boldsymbol{\eta}_{jk}^{(2)}$ induce dependence between different students for a school; and, finally, municipality level latent variables $\delta_{ijk}^{(3)}$ are composed as

$$\delta_{ijk}^{(3)} = \boldsymbol{\beta}_{k}^{(3)\prime}\mathbf{z}_{ijk}^{a(3)} + \boldsymbol{\gamma}_{k}^{a(3)\prime}\mathbf{z}_{ijk} + \boldsymbol{\lambda}^{a(3)}\boldsymbol{\eta}_{k}^{(3)}. \tag{12}$$

The multinomial logit model can include both individual-specific and alternative-specific covariates.

A mixed logit model for multilevel data is estimated in order to analyze the choices of high school leavers regarding higher education. The data is presented in the next subsection, and after that we present some results, which were obtained with GLLAMM, a STATA program to fit Generalized Linear Latent and Mixed Models.

4.2 Data and variables

The data set in this study comes from the RUBS (*Registratie Uitstroom en Bestemming van Schoolverlaters*) survey, conducted by the ROA among those individuals who receive a leaving report from a high school, from both HAVO and VWO tracks. These individuals were interviewed 18 months after leaving school. That is, 1999, 2000, and 2001 surveys in use in this study refer to 1997/98, 1998/99, and 1999/2000 school leavers' cohorts, respectively. Individuals are asked personal characteristics, as well as their current situation at the time of the survey: whether they were studying, whether they were working or out of the labor force. Some identification information on high schools and on institutions where students attend further education is also available; namely, institution name and location.

We select a sub-sample consisting of school leavers, who received a leaving report either from HAVO or from VWO, and who got a diploma for that education level. Those who do not satisfy these conditions or who had missing values on the variables that were used for the analysis were excluded. There are some high schools with more than one establishment in our original sample, meaning that schools are not independent of each other. In order to prevent problems arising from this type of correlation, we select only

one establishment of each school to take part of the sample. This resulted in a sub-sample of 6487 individuals.

The variables that we use for the present analysis are designated by ST- if they refer to student, by HS- if they refer to the high school, by MU- if municipality level variables. Some descriptive statistics on the variables can be found in appendix A.

(A) Student decision as an outcome variable School leavers are asked their main activity at the moment of the survey, and which type of education they are attending, if they are students. Based on this information, a choice variable is created. From the structure of the Dutch higher education system follows that different individuals face different alternative sets. While students with a VWO diploma choose among university, professional colleges and out of higher education, those who attended HAVO can only opt between professional colleges and out of higher education. Such differences in the sets of possible response categories are accommodated in our model.

CHOICE = 1: no higher education; 2: Vocationa Colleges; 3: University.

(B) Student-specific variables The individual variables are constructed based on RUBS data set, for 1999, 2000, and 2001. At the student level, we consider variables such as age, gender, nationality, and family nationality. Some variables related with school career, such as average grade in final exams, the high school track, and the high school profile, are also included.

Gender: **st-male.**

ST-MALE = 1: male student; 0: otherwise.

Age: **st-age.**

ST-AGE = age at the moment of the survey.

Nationality: **st-dutch.**

ST-DUTCH = 1: Dutch student; 0: otherwise..

Family nationality: **st-bkducth.**

ST-BKDUCTH = 1: both parents are Dutch; 0: otherwise..

School performance: **st-gpa.**

ST-GPA = average grade in final exams.

School profile: **st-tech, st-science, st-econom, st-culture.** There are four profiles among which students have to choose. Different profiles correspond to a common set of disciplines, plus a group of profile specific courses. Since economics and society is the most frequent profile, it was omitted and considered as the base category.

ST-TECH = 1: science and technology; 0: otherwise.

ST-SCIENCE = 1: science and health care; 0: otherwise.

ST-ECONOM = 1: economics and society; 0: otherwise.

ST-CULTURE = 1: culture and society; 0: otherwise.

***Job search*: st-search**

ST-SEARCH = 1: student searched for a job in the last year at school; o: otherwise.

(C) School-specific variables The number of students in the establishment, the type of high school, the tracks that are offered in the establishment, and the average grades in final exams are the variables at the high school level. The high school characteristics were obtained through the yearly quality reports, on each high school in Netherlands, which are evaluated by educational inspection authorities (*Inspectie Onderwijs*).

***Size of the school*: hs-stud.**

HS-STUD = number of students in the high school.

Type of school: **hs-public, hs-private, hs-privrel.** There are several types of high schools in the Netherlands, which mainly differ in terms of their denomination. Private religious high schools are the base category.

HS-PUBLIC = 1: public high schools, including public and municipal schools; 0: otherwise.

HS-PRIVATE = 1: private (non-religious) high schools; 0: otherwise.

HS-PRIVREL = 1: private, religious high schools; 0: otherwise.

(D) Municipality-specific variables At the municipality level, we include the average income per capita, and population density (*mu_pop*).

Income per capita: **mu-incpc.**

MU-INCPC = income per capita in the municipality.

Population density: **mu-popdens.**

MU-POPDENS = population density in the municipality.

***Vocational colleges*: mu-hbo**

MU-HBO = 1: there are (at least one) professional college in the municipality; 0: otherwise.

***Universities*: mu-wo**

MU-WO = 1: there are (at least one) university in the municipality; 0: otherwise.

5 Empirical results

We first estimate a multinomial logit model, with random intercepts, for two-level data; that is, we just take into account that students are nested within schools. Table 1 presents the main results.

Table 1: Mixed logit model for a two level (hierarchical) data, with students nested within schools

	Choice			
	2: Voc. College		**3: University**	
Variables	**coeff.**	**(st-error)**	**coeff.**	**(st-error)**
st-male	0.0385	(0.0828)	0.3952*	(0.1118)
st-age	0.1138**	(0.0465)	-0.2073*	(0.0736)
st-dutch	0.1621	(0.2081)	-0.14232	(0.2964)
st-bkdutch	-0.1034	(0.1222)	-0.4475*	(0.1680)
st-gpa	0.6089*	(0.0745)	1.5399*	(0.1010)
st-tech	0.3029*	(0.1053)	0.8626*	(0.1358)
st-science	0.2388**	(0.1095)	0.3023**	(0.1511)
st-culture	0.0521	(0.1086)	0.0456	(0.1512)
st-search	-1.0412*	(0.0973)	-1.1802*	(0.1433)
hs-stud	0.0001	(0.0001)	0.0001	(0.0001)
hs-public	-0.0713	(0.1221)	0.4939*	(0.1981)
hs-private	-0.22	(0.1827)	0.2328	(0.2989)
mu-incpc	-0.0928	(0.1066)	0.3681**	(0.1759)
mu-popdens	0.0001	(0.0000)	-0.0001	(0.0001)
mu-hbo	-0.0723	(0.1399)	-0.037	(0.2245)
mu-wo	-0.1219	(0.1489)	0.5837**	(0.2341)
cons	-4.1087*	(1.4889)	-7.5563*	(2.4174)
var(1)		0.0384 (0.0235)		
cov(2,1)		0.0603 (0.0329		
cor(2,1)		0.7824		
var(2)		0.1549 (0.0619)		
log-likelihood		-4013.24		

Note: Significance at the 1, 5, and 10% level is indicated with *, ** and ***, respectively.

Results in Table 1 show a not significant effect of students nationality (ST-DUTCH), the dimension of the high school (measured by means the number of students, HS-STUD), private high schools (hs-private), and the urbanization level of the municipality (proxied

by the population density, MU-POPDENS), on both probabilities of studying at universities and professional colleges. The effect of the existence of a vocational college within the municipality is also not significant in both cases when compared with the no higher education alternative.

The older the student, the higher the probability of opting for vocational colleges than working, but the lower the probability of going to university, when compared with the no higher education alternative. Students whose both parents are Dutch are less likely to go to university.

There are no significant gender differences, except for the fact that male students are more likely to enroll at university, rather than work, than female students. As expected, student's previous performance seems to have a positive impact on the decision to continuing at school (see the positive coefficient of ST-GPA). The higher the student average grade in the final exams, the higher the probability of choosing vocational college or university instead of a no higher education alternative. Although the Dutch higher education system does not select students at entrance, students seem to select themselves, with students with better performance at high school being more likely to attend university or vocational college.

It appears that those students who want to leave school after the secondary level start looking for a job while at school. Students attending either vocational colleges or universities are less like to have looked for a job in their last year at secondary education.

Individuals that follow either a technical or a science profile in the high school are more likely to choose a higher education career, when compared with the no higher education alternative, than students from economics (which is the base category). Nevertheless, students attending the culture profile do not significantly differ from those in economics, in what concerns to their choices.

The higher the income per capita in the municipality, the more likely students go to university compared to no higher education option. The existence of a university in the municipality where students attend secondary education makes them more likely to attend a university program, rather than opt for no higher education.

6 Conclusions

Previous literature find that school leavers' decisions are determined by a wide range of individual, institutional and regional factors, but the multi-level structure of the educational data has hardly been recognize. Furthermore, in a context of spatial clustering both spatial heterogeneity and spatial auto-correlation are likely to be present. Because grouping cannot be ignored, we tested for the existence of school and regional effects on school leavers' decisions among young people who left high school, in The Netherlands, during the period 1998-2000.

In the present study we considered a two level hierarchical structure, with students nested within schools. We want now to extend the analysis to the three-level structure referred above, according to which students are nested within schools, which in turn are nested in municipalities. We are also looking for a better measure of the accessibility to vocational college and university education within each municipality.

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A Descriptives

Table 2: Descriptive statistics, by choice category

	Choice					
	1: no higher education		**2: Voc. College**		**3: University**	
Variables	**mean**	**(st-error)**	**mean**	**(st-error)**	**mean**	**(st-error)**
Student characteristics						
st-male	0.3485		0.3708		0.4474	
st-age	18.8470	(0.8449)	18.8664	(0.8358)	19.2893	(0.6557)
st-dutch	0.9605		0.9659		0 .9579	
st-bkdutch	0.8622		0.8690		0.8517	
st-gpa	6.4127	(0.5591)	6.5937	(0.5271)	6.9243	(0 .6556)
st-tech	0.1702		0.2297		0.4596	
st-science	0.1459		0.1660		0.1356	
st-culture	0.1631		0.1522		0.1278	
st-search	0.2361		0.0949		0.0915	
High school characteristics						
hs-stud	1388.6010	(642.4477)	1431.0810	(641.1637)	1316.3540	(595.6804)
hs-public	0.2503		0.2372		0.2457	
hs-private	0.0790		0.0633		0.0817	
Municipality characteristics						
mu-incpc	9.6022	(0.6175)	9.5981	(0.5890)	9.6296	(0.6514)
mu-popdens	2205.1990	(1477.1430)	2219.9590	(1565.6950)	2265.8620	(1417.7510)
mu-hbo	0.4975		0.4802		0.5066	
mu-wo	0.2725		0.2439		0.3348	
Nr of observations	987		3457		2043	