AALBORG UNIVERSITY

Unequal Access to Universities in a Country with High Social Equality

A Multinomial Latent Transition Analysis of Horizontal and Vertical Stratification

Munk, Martin D.; Baklanov, Nikita

[Link to publication from Aalborg University]

Unequal Access to Universities in a Country with High Social Equality: A Multinomial Latent Transition Analysis of Horizontal and Vertical Stratification

Martin D. Munk*

Nikita Baklanov*

DRAFT

August 9, 2014

*'**Centre for Mobility Research, Aalborg University Copenhagen, and *Centre for

Stratification Research, Denmark.

Corresponding author:

Martin D. Munk, Centre for Mobility Research, Aalborg University Copenhagen, A.C.
Meyers Vaenge 15 (FKJ10B), DK-2450 Copenhagen SV, Denmark.
E-mail: mdm@dps.aau.dk

ABSTRACT[1]

In this paper, we use a multinomial latent transition model and Danish register data to jointly model multiple choices of high school, university, field of study, and rank of university (elite versus non-elite). The models imply that groups choosing at later stages are more and more homogenous.

Estimations of our model 1 show that access to high school is open to students from different families, but not to the same degree for students from an unskilled background, and the students from homes with high family income, academic education, fathers and mothers in the professions, and females are more likely to choose gymnasium. The results also show a social gradient at the university level with males being more likely to become a graduate student. The choice of elite university is even more exclusive since especially students with relatively wealthy, highly educated parents, and mothers with a professional background have a higher chance of entering. Social selection is increasing at a lower level of strength.

Our model 2 shows that students from families with higher levels of income are more likely to choose health sciences, social and natural sciences than the humanities. Also individuals with university educated fathers and mothers are more likely to choose health sciences than the humanities. Males are more likely than females to choose social and natural sciences than the humanities and health sciences.

In addition, our model 3 shows that selection into health sciences is very clear. Mothers' education is still very important, in particular the choice of elite health programs, but also in the humanities, and social sciences. Likewise, father's education is important in explaining the choice of health programs, natural sciences and to some degree the social sciences. Surprisingly, males are more likely to choose elite humanities than females, lifted by mothers in higher professions, whereas females are more likely to choose elite social sciences. Students living in urban areas are more likely to enter elite universities. Family income of the parents still plays a part in choosing elite social sciences.

INTRODUCTION

Numerous studies show that access to higher education is not equal for all (Alon 2009; Gerber and Cheung 2008; Hällsten 2010; Jackson 2013; Shavit Arum, and Gamoran 2007). Within the past 5 or 10 years studies have tried to study more educational stratification since scholars assume that access to selective universities and fields of study are socially exclusive. However, results are somewhat mixed. In our view, we think that a more precise model of the plural selection processes taking unobserved heterogeneity into account will improve the analysis of horizontal stratification in higher education.

What, we offer in this paper is an attempt to model choices – selection – of university, field of study, and rank of university (elite versus non-elite) by using a multinomial latent transition model with unobserved heterogeneity which first enables us to jointly to model choice of three stages: high school (gymnasium), university level, and elite-university. Secondly, we model three stages including choices leading into to the university level, and a four-field of study. Finally, we use a latent class analysis with field of study as the first transition and rank as the second transition. The three models help us to better understand the selection process and horizontal stratification in higher education.

LITERATURE REVIEW

Internationally the sociology of higher education has been a fast growing field (for overviews, see Gerber and Cheung 2008; Stevens, Armstrong and Arum 2008; Grodsky and Jackson 2009). The continuing importance of family background in access to higher education is well-documented both internationally (see Shavit et al. 2007) and in Denmark (Benjaminsen 2006; McIntosh and Munk 2007; Karlson 2011). Research in this field has focused mainly on vertical educational mobility, and recent Danish studies

show that vertical mobility has increased from 1985 to 2005, implying that enrolment at the university level is, albeit still unequal, now less dependent on family background than it was earlier, especially for women from a lower socio-economic background (McIntosh and Munk 2013; Munk 2014).

The horizontal social stratification *within* higher education has received less attention in the research literature. However, som years back Davies and Guppy (1997) investigated the relationship between SES, chosen field of study, and college selectivity, and they found that students from a stronger social origin with more economic and cultural resources are more likely to enter selective universities and programs. Karen (2002) confirmed an increased competition for access to elite institutions.

Later on, Triventi (2013) compared eleven European countries, and argues that horizontal inequalities and institutional differentiation in higher education is more pronounced in countries with a high proportion of tertiary graduates. In another study Hällsten (2010) states that horizontal stratification in higher education is a significant factor in social reproduction, and finds that class background affects higher education program choice. Along the same line, Zarifa (2012) also finds social background effects for economically lucrative fields of study. Some studies do not find these effects. Reimer and Pollak (2010) examine the expansion of higher education in West Germany 1983-1999 and find that, except for the socially exclusive fields of 'medicine and law', horizontal differentiation is not particularly visible between five fields. Jackson et al. (2008) make a comparative examination of fields of study and intergenerational mobility. They do not find support for the need to differentiate between fields of study in relation to an OED model, but they have several reservations.

However, Brint and Karabel (1989) have argued that first generation students are channeled into less prestigious, vocationally oriented fields and programs, whereas

thestudents from the most privileged backgrounds are directed towards the most prestigious higher education institutions (Espenshade and Walton 2009, Karabel 2005). Here, relative risk aversion theory (RRA) stresses that the potential propensity of working-class students to favor less prestigious, applied programs, is due to the fact that these educational choices are viewed as less risky in terms of future outcomes (see Breen and Goldthorpe 1997). Boudon (1974) argues that different class origins will produce different cost-benefit calculations, leading children from higher educated families to be less risk-averse when it comes to program length and type than their working-class counterparts. From a field-theoretical perspective, these micro-sociological rationales would be viewed more as structurally limited choices. Bourdieu (1996) regards higher education institutions as a field where families compete for attractive social positions mediated by gaining access to prestigious higher education programs. The educational strategies of families with large amounts of cultural capital will be to seek out and monopolize specific institutions and fields of studies. As an outcome of the social struggles in the higher education field, some families will inhabit the less dominant positions; the types of institutions and programs in which students from lower educated homes will statistically be found.

RESEARCH HYPOTHESES

The analysis targets both the vertical and horizontal level of educational outcomes. We add to existing knowledge by working with a detailed parental occupational classification, by controlling for transitional selection and unobserved heterogeneity bias, and by offering a joint model 1 of gymnasium, university level, and rank of university, a model 2 of field of study in which we control for the transition into the university level, a model 3 combining field of study and university rank in our dependent variable. We posit that, in spite of high social equality in Denmark, choices

at different levels leading up to choice of university level, rank (elite versus non-elite) and field will be more and more exclusive and selective (measured by social origin), and that a detailed classifications of parents' occupational status will add to the explanation of the dynamics of this selectivity. This leads us to hypothesize the following:

Even when taking transitions and unobserved heterogeneity into account, we expect that choice of field of study and institutional rank will be socially eschewed: Students from working class families will be more likely to choose the less selective non-elite universities given an easier access, whereas students from academic families are more likely to choose the selective elite universities given a harder access. Additionally, students will be more likely to choose a given field, if their parents are educated within that field.

MODELS, METHODS AND DATA

The empirical strategy of this analysis consists of modelling the vertical stratification for each education choice on the path towards a university degree from a range of demographical and parental characteristics of the student; as well as modelling the horizontal stratification within university education with respect to the rank of institution and field of study. While the primary focus of this analysis is to test for the presence of horizontal stratification within university education, the inclusion of vertical transition serves several important functions: i) by modelling the full educational pathway, we are able to minimize the bias of from selection and hence estimate the true effects of background variables on the horizontal stratification; ii) the vertical stratification serves as a point of reference to horizontal stratification at the top; iii) finally the complete models show which characteristics contribute in to the overall stratification to and within academic education and which point the contributions occur.

In the models, we apply a grouping of field of study with four categories: humanities (including business language, literature, arts, theater studies, philosophy, history, language, architecture, music conservatories, journalism, media and communication), social sciences (including business economics, sociology, psychology, anthropology, economics and law), natural sciences (biology, geography, physics, mathematics, chemistry), and technical sciences (mainly engineering and agriculture) collapsed, and finally health sciences (medicine, dentistry, public health science, pharmaceutical science).

We use a division of elite and non-elite universities following international ranking lists (Munk et al. 2014). The elite universities include University of Copenhagen (KU), Aarhus University (AU), Technical University of Denmark (DTU), and Copenhagen Business School (CBS). The none-elite universities include University of Southern Denmark (SDU), Aalborg University (AAU), Roskilde University (RUC), and Aarhus School of Business (ASB).

Multinomial transition model with unobserved heterogeneity

The empirical model implemented in the analysis is based on the multinomial transition model with unobserved heterogeneity (MTMU) developed by Karlson (2011). In its general form this model can estimate K transitions with A_k educational alternatives in the k-th transition (while A can be different for each k-th transition, it will be used without indexation for k in the remainder of this section in order to ease notation). Alternatively the MTMU can be considered as a K sequential multinomial logit model with unobserved heterogeneity. Formally the MTMU can be expressed in terms of the conditional multinomial probability of choice a in transition k for individual i as:

$$P(y_{ik} = a | x_{ik}, v_{akw}) = \frac{\exp\left(\sum_{j=1}^{J} \beta_{akw} x_{ij} + v_{akw}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \beta_{skj} x_{ij} + v_{skw}\right)}$$

where x_{ij} is the j-th explanatory variable with a logit coefficient β_{akw} for alternative a of transition k. v_{akw} is the effect of the unobserved variable (*mass point location*) for a latent class w for a and k. If we further assumes a total of W latent classes, so that π_w is the share (*weight*) in latent probability $w = 1, 2, ..., W$ and $\sum_{w=1}^{W} \pi_w = 1$. Hence the multivariate probability unconditional on unobserved variable is:

$$P(y_{ik} = a, a'|x_{ik}) = \sum_{w=1}^{W} \left(\prod_{k=1}^{K} P(y_{ik} = a|x_{ik}, v_{akw})^{I_k} \right) \pi_w$$

where I_k is an indicator variable for transition k, which takes value 1 if transitions $1, ..., k-1$ are survived, and zero otherwise. As all students participate in (survive until) transition 1, I_1 is equal to 1 for all students.

Model specifications

We present three models, each of which is a special case of the MTMU. We assume two latent classes in all three models, i.e. $W = 2$, with different mass point locations for each transition and alternative (however this was not possible in all model estimations). Model 1 consists of three transitions with only two alternatives in each, i.e. $K = 3$ and $A = 2$. This model respectively estimates the vertical stratification: in *transition 1* from compulsory education to (academic) higher secondary education (gymnasium) and in *transition 2* from gymnasium to university (LVU) and the horizontal stratification in *transition 3* between elite and non-elite institution.
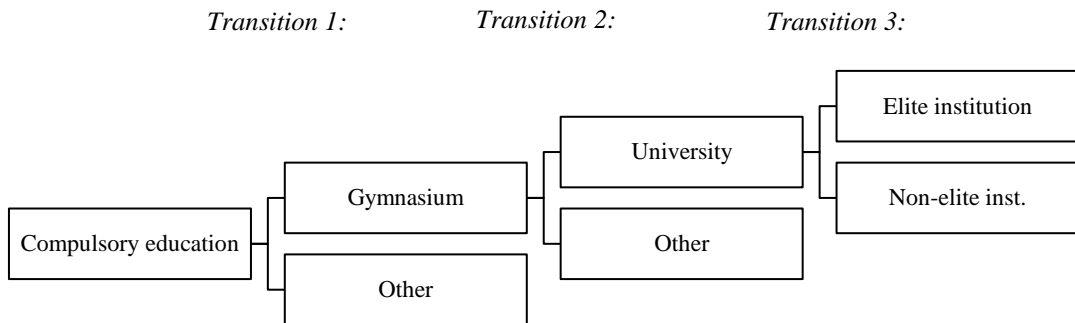
Model 2 consists of only two transitions with 2 and 4 alternatives respectively, i.e. $K =$, $A_1 = 2$ and $A_2 = 4$. *Transition 1* combines all of the vertical stratification in model 1 (transition 1 and 2) in a single transition stage. This is done largely to simplify the model, while controlling for the selection into university. In *transition 2* we model the choice between different fields of study (*humanities*, *social sciences*, *natural & technical sciences*, and *health sciences*) after survival into university.
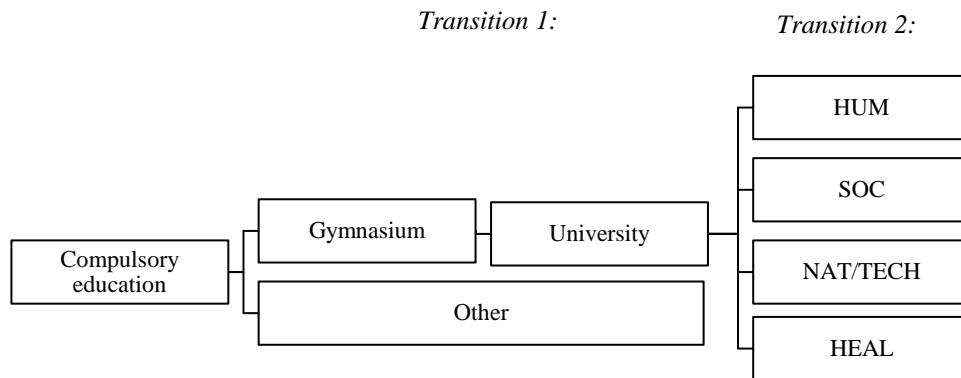
Model 3 is in reality in four separate models with slightly different specifications. These models consist of two stages with two alternatives each, i.e. $K = 2$ and $A = 2$. *Transition 1* is the combined stratification to gymnasium, university and <u>one</u> of the four fields of study (e.g. *HUM*), while *transition 2* captures the choice between elite and non-elite institutions. Again transition 1 is simply included in order to account for the selection into a given field of university, while the transition 2 of interest models the choice between institutions, given that the students has already chosen a field (and has been accepted).
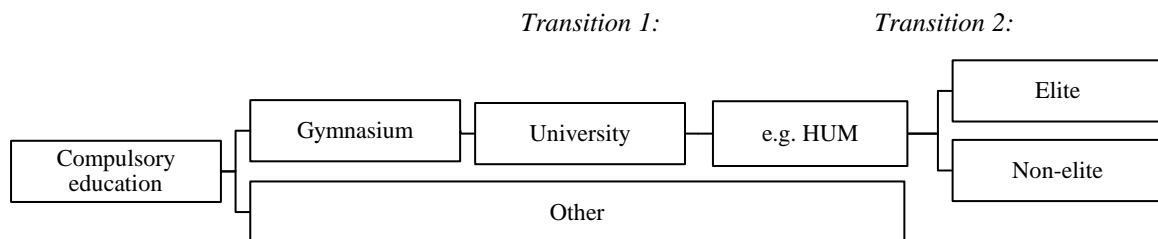
Data and variables

We use register data on all individuals born in 1984 (54,734 observations) and their university enrolment status at age 24. The vast majority of Danish university students pursues a master's degree, and completes typically after the age of 24.

The register variables used as explanatory variables have been re-coded on the basis of a large number of preliminary alternative model specifications. The explanatory register variables are based on Statistics Denmark register data from 2000 (when the respondents were 16 years old), unless otherwise specified. A series of dummy variables are used to control for family and individual background differences: Female; Non-western − all immigrants or descendants of immigrants from non-western countries; Urban − capturing all students living in either Copenhagen or Aarhus when they were 16 years old (the two largest cities in Denmark); and nuclear family – all individuals living with both parents in 2000. The ages of both parents are included as a numeric variable. Family income is measured as the combined gross income of parents divided by DKK 100,000 (approx. 15,000 euros). Parental education is captured by an ordinal variable with 5 categories: Primary School; Gymnasium (High School); Vocational Education and Training (VET); Short or intermediate higher education (business academies and university colleges), and longer higher education (universities). A categorical variable for parents' occupation is used for each parent. The categories are constructed on the basis of the International Standard Classification of Occupation, ISCO, and coded in a way that enables the separation of groups with different resources or capitals, especially within the higher classes, taking into account the importance of the occupations' distinctive socialization patterns (Bourdieu 1986; Nordli Hansen 2006; Weeden and Grusky 2005). Here, fathers' occupations are divided into 13 categories in model 1 and 8 categories in model 2 and model 3, while some of the occupational

categories have been merged for mothers, stemming from the fact that mothers' occupations are more homogeneous.

Instrument variables

An essential precondition of the identification strategy is the presence of instrumental variables. In the current model an effective instrumental variable must be correlated with the first discrete choice, but be uncorrelated with the subsequent discrete choice. Hence, in order to successfully capture the unobserved effect in a three stage transition model, at least two instrumental variables must be used: i) one which is correlated with the choice to attend a Gymnasium education but uncorrelated with the choice to attend university; ii) a second must be correlated with the choice of attending university but be uncorrelated with the choice between elite and non-elite universities. An often used instrumental variable for the transition from Gymnasium to university is commuting distance for home to nearest Gymnasium institution. The logic behind this variable is that youths, who are considering attending Gymnasium, can be discouraged by long commuting times. Typically, such youth are between 16 to 19 years old and predominantly living with their parents. Given these demographical characteristics and a minimum age of 18 years to receive student grants, few potential Gymnasium students would be willing to move closer to a Gymnasium institution and are therefore largely constrained by their commuting distance. On the contrary potential university students have a higher geographical mobility, as almost all are eligible for full student grants and university education is available in only a few of cities.

Unfortunately, no information about distances between home and the nearest Gymnasium institution were available in the data for this analysis. Instead we attempted to construct several alternative variables inspired by the similar logic based on the geographical division of Denmark into 275 municipalities. Specifically we tested

several instrument variables on the presence of different educational institutions within municipality of residence in year 2000, when the majority of our population completed compulsory education. An initial test using the count of gymnasiums within the municipality of residence revealed that, while it was highly correlated with completion of a gymnasium education, number of gymnasiums was also positively correlated with university attendance and therefore unsuited as an instrument variable. Potentially, this can be explained by a larger concentration of gymnasiums in municipalities with higher preference for university education, for which a gymnasium education is a prerequisite. Similarly, gymnasiums are likely to cluster around the university towns.

On the contrary, presence of vocational educational institutions and their departments within the municipality of residence was found to be negatively is correlated with gymnasium completion and uncorrelated with university attendance, hence making it a suitable instrument. As vocational education is the primary educational alternative to gymnasium, it seems intuitive that greater availability (proxied by presence in municipality) of this education would increase students' propensity to choose vocational education rather than gymnasium. Furthermore, as completion of a vocational education does not grant access to university, its geographical location is less likely to concentrate around university centers.

The final set of instruments variables for the first transition consisted of:

- Number of vocational schools and local departments in the municipality
- Dummy variable for no vocation schools in the municipality

Similar reasoning was used to derive an instrument variable for the second transition, which had to be correlated with the choice of attending university but not with horizontal choice of within university rank and/or field of study:

- Number of colleges (institutions for short and intermediate further education) within the residence municipality.

The intuition behind this instrument is that ease of access to short and intermediate further education (major alternative to university) will increase the relative preference for these educations and hence reduce preference for university. While initial tests revealed that number of college departments offered within the municipality of residence was not correlated with choice of university field of study, it was contrary to intuition positively correlated with choice to attend university. This is likely due to the co-concentration of university and college departments within large city centers. Despite the counter-intuitive direction of the correlation, the count of college departments within the municipality is still correlated with university enrolment and uncorrelated with choice of university field. Hence this instrument still fulfills the technical requirements and is therefore suitable in the identification strategy.

RESULTS

Because we want to investigate the significance of specific resources present in the children's social origin, we use a categorization of parental occupations to allow for the identification of different forms of capital, especially if one or both parents have further or higher education.

The following section presents the results of the three models described in the previous section. The regression estimates are presented as logit coefficients or log odds. As the interpretation and comparability of magnitude of logit coefficients is limited across transitions due to the problem of rescaling, the results are additional presented using average partial effects (APE) (Cramer 2007; Mood 2010; Karlson et al. 2012). APE states the effect of one unit change in the explanatory variable on the probability of the outcome, $P(Y=y)$. The APEs were manually calculated in Stata based on the methods presented in Bartus (2005). For the multinomial choice of transition 2 in model 2, the presented APEs are normalized with respect to the baseline alternative in order to

evaluate the magnitude of the quantified effects presented by logit coefficients (Karlson, 2011).

In model 1 we present a joint latent class transition analysis of choice of gymnasium, university level, and rank of university.[2] Estimations show that access to high school – stage 1 – is relatively open to students from most families, but not to the same degree for students from an unskilled social background as for students with other social origins. On the overall level, the chance of attending gymnasium are higher for students from homes with high family income, parents holding professional positions, or with a gymnasium or university degree. Females are more likely to choose gymnasium.

Table 1: Model 1, MTMU

	Logit coefficients (Standard errors)						APE		
	Gymnasium		University		Elite		Gymnasium	University	Elite
Female	1.084***	(0.03)	-0.315***	(0.09)	-0.015	(0.04)	0,200	-0,047	-0,003
Non western Immigrant	0.298***	(0.05)	0.659***	(0.13)	0.020	(0.13)	0,055	0,105	0,004
Urban (Copenhagen and Aarhus)	-0.127***	(0.03)	0.155***	(0.05)	0.734***	(0.06)	-0,024	0,024	0,150
Mothers age	0.017***	(0.00)	0.007	(0.00)	0.008	(0.01)	0,003	0,002	0,003
Fathers age	0.035***	(0.00)	0.034***	(0.01)	0.014**	(0.01)	0,005	0,011	0,005
Nuclear family	0.105***	(0.03)	0.010	(0.06)	-0.113	(0.07)	0,019	0,002	-0,023
Family income (100.000 DKK)	0.313***	(0.02)	0.122***	(0.03)	0.084***	(0.03)	0,048	0,038	0,030
Fathers occupation (ref: Unskilled workers)									
- Machine operators	0.206***	(0.04)	0.009	(0.09)	-0.215	(0.13)	0,040	0,001	-0,043
- Skilled craft workers	0.290***	(0.08)	0.023	(0.08)	-0.119	(0.11)	0,056	0,004	-0,024
- Skilled agricultural/ fishery workers	0.311***	(0.06)	0.224*	(0.12)	-0.193	(0.15)	0,060	0,036	-0,039
- Sales, service and care work	0.377***	(0.06)	0.192	(0.12)	0.249	(0.16)	0,073	0,031	0,051
- Clerks	0.539***	(0.06)	0.055	(0.12)	0.135	(0.16)	0,104	0,009	0,028
- Sales, finance, business, administration	0.711***	(0.06)	0.196*	(0.10)	0.085	(0.13)	0,136	0,031	0,017
- Technicians and associate professionals	0.602***	(0.06)	0.146	(0.10)	-0.124	(0.13)	0,115	0,023	-0,025
- Professionals – arts and social sciences	1.098***	(0.08)	0.514***	(0.12)	0.099	(0.13)	0,203	0,083	0,020
- Teaching professionals	0.887***	(0.07)	0.390***	(0.11)	0.127	(0.12)	0,167	0,063	0,026
- Science professionals	0.773***	(0.07)	0.545***	(0.12)	0.216*	(0.13)	0,147	0,088	0,044
- Managers	0.431***	(0.06)	0.016	(0.12)	0.158	(0.15)	0,083	0,002	0,032
- Legislators, senior officials	0.721***	(0.06)	0.340***	(0.11)	-0.052	(0.13)	0,137	0,055	-0,011
Mothers occupation (ref: Unskilled workers)									
- Machine workers and skilled craft workers	0.038	(0.05)	-0.147	(0.12)	-0.022	(0.17)	0,007	-0,023	-0,005
- Skilled agricultural and fishery workers	0.190***	(0.04)	-0.098	(0.09)	0.015	(0.13)	0,037	-0,015	0,003
- Sales, service and care work and clerks	0.612***	(0.05)	0.111	(0.09)	0.055	(0.13)	0,118	0,018	0,011
- Sales, finance and business administration	0.634***	(0.06)	0.295***	(0.11)	0.177	(0.14)	0,122	0,047	0,036
- Technicians and associate professionals	0.490***	(0.05)	0.113	(0.10)	0.165	(0.13)	0,095	0,018	0,034
- Professionals - arts and social sciences	0.949***	(0.09)	0.622***	(0.15)	0.271*	(0.16)	0,178	0,101	0,055
- Teaching professionals	0.952***	(0.07)	0.555***	(0.13)	0.400***	(0.14)	0,179	0,090	0,082
- Science professionals	0.832***	(0.10)	0.566***	(0.16)	0.288*	(0.16)	0,158	0,092	0,059
- Legislators and senior officials, managers	0.404***	(0.07)	0.331**	(0.14)	0.257	(0.16)	0,078	0,053	0,053
Fathers education (ref: Compulsory education)									
- High school (gymnasium)	0.960***	(0.06)	0.410***	(0.11)	0.321***	(0.12)	0,179	0,067	0,066
- Vocational education	0.305***	(0.03)	0.003	(0.06)	0.091	(0.08)	0,059	0,001	0,019
- Short/medium higher education	0.693***	(0.04)	0.261***	(0.07)	0.112	(0.08)	0,132	0,042	0,023
- Long higher education	1.030***	(0.06)	1.064***	(0.18)	0.354***	(0.10)	0,191	0,171	0,072
Mothers education (ref: Compulsory education)									
- High school (gymnasium)	0.812***	(0.06)	0.559***	(0.10)	0.128	(0.12)	0,154	0,092	0,026
- Vocational education	0.362***	(0.03)	0.187***	(0.05)	0.056	(0.07)	0,070	0,031	0,011
- Short/medium higher education	0.706***	(0.04)	0.531***	(0.08)	0.041	(0.08)	0,134	0,087	0,008
- Long higher education	0.913***	(0.08)	1.681***	(0.32)	0.395***	(0.14)	0,171	0,257	0,080
Instrumental variables									
Number of vocational Schools in municipality	-0.014***	(0.00)	-	-	-	-	-	-	-
Dummy - No vocational Schools in municipality	-0.124***	(0.03)	-	-	-	-	-	-	-
Number of SFU & MFU Intitutions in municipality	-	-	0.011***	(0.00)	-	-	-	-	-
Constant	0.130***	(0.01)	-1.475***	(0.15)	-0.375	(0.50)	-	-	-
u	0.378*	(0.22)	-3.180***	(0.58)	-1.401	(1.49)	-	-	-
a	-0.894***	(0.30)					-	-	-
N	89.392								

Categories for missing parent age and occupation and family income are included.

*, **, *** significant on a 10%, 5% and 1% level, respectively.

In stage 2, it is clearly that results show a social gradient at the university level with males being more likely to enroll. In particular, it turns out that university educated mothers heavily increases the chances of attending university (see APE estimates), but also having a non-western immigrant origin and, university educated fathers, and mothers in arts and social science professions particularly increases the likelihood of attending university. However, the analysis also shows that students from a different social background enter universities that are less socially selective (like Aalborg

University, University of Southern Denmark and Aarhus Business School), likely because they offer less competitive programs (they do not require a high GPA to enter) and because some of them are sited in regions of Denmark where the average skill level of parents is lower.

The last column of model 1 shows that choice of elite university is even more exclusive since especially students with relatively wealthy, highly educated parents, and mothers with a professional background have a higher chance of entering. Hence social selection is increasing and present at the top of the horizontal stratification but at a lower level of strength compared to the comprehensive selection within the first two transitions towards university education.

Field of Study (Ref: Humanities)	Logit coefficients (Standard errors)						Normalized APE		
	Social Sc.		Natural Sc.		Health Sc.		Social Sc.	Natural Sc.	Health Sc.
Female	-0.583***	(0.06)	-0.993***	(0.06)	0.292***	(0.08)	-0,402	-0,472	-0,053
Non western Immigrant	0.387***	(0.14)	-0.024	(0.17)	1.496***	(0.17)	-0,208	-0,038	0,467
Urban (Copenhagen and Aarhus)	0.128**	(0.06)	-0.049	(0.06)	-0.019	(0.08)	0,140	-0,030	0,004
Nuclear family	-0.288***	(0.08)	-0.039	(0.09)	-0.191	(0.12)	-0,191	0,002	-0,088
Family income (100.000 DKK)	0.286***	(0.03)	0.132***	(0.04)	0.363***	(0.04)	-0,053	0,099	0,366
Fathers occupation (ref: Unskilled workers)									
- Skilled workers	-0.034	(0.12)	0.102	(0.14)	-0.017	(0.19)	-0,054	0,059	0,003
- Sales & Service	0.024	(0.13)	-0.027	(0.15)	-0.165	(0.21)	0,082	-0,008	-0,045
- Technicians and associate professionals	-0.193	(0.15)	0.237	(0.17)	0.038	(0.23)	-0,224	0,147	0,016
- Professionals	-0.148	(0.13)	-0.007	(0.15)	-0.169	(0.19)	-0,083	0,012	-0,063
- Managers, legislators and senior officials	-0.007	(0.14)	-0.049	(0.16)	-0.491**	(0.21)	0,161	-0,004	-0,132
Mothers occupation (ref: Unskilled workers)									
- Skilled workers	0.299	(0.20)	-0.051	(0.23)	-0.360	(0.38)	0,462	-0,025	-0,063
- Sales & Service	0.156	(0.14)	-0.101	(0.15)	0.122	(0.23)	0,132	-0,061	0,040
- Technicians and associate professionals	0.131	(0.16)	-0.011	(0.17)	0.376	(0.25)	-0,010	-0,026	0,121
- Professionals	-0.016	(0.16)	-0.184	(0.17)	0.249	(0.25)	-0,033	-0,099	0,050
- Managers, legislators and senior officials	0.201	(0.19)	-0.313	(0.21)	-0.165	(0.31)	0,377	-0,159	-0,058
Fathers education (ref: No professional qualification)									
- Vocational education	0.124*	(0.07)	0.213**	(0.09)	0.042	(0.12)	0,021	0,103	0,052
- Short/medium higher education	0.042	(0.08)	0.174*	(0.09)	0.219*	(0.12)	-0,085	0,076	0,086
- Long higher education	-0.064	(0.11)	0.118	(0.13)	0.421***	(0.15)	-0,198	0,042	0,129
Mothers education (ref: No professional qualification)									
- Vocational education	0.098	(0.08)	0.025	(0.09)	0.284**	(0.13)	-0,017	-0,005	0,095
- Short/medium higher education	-0.032	(0.08)	0.010	(0.10)	0.295**	(0.13)	-0,114	-0,007	0,083
- Long higher education	-0.060	(0.15)	0.163	(0.16)	0.537***	(0.19)	-0,233	0,054	0,169
Constant	0.198***	(0.04)	-0.280***	(0.04)	-1.475***	(0.06)	-	-	-
u	1.128	(1.18)	0.606	(1.39)	0.236	(1.29)	-	-	-
a	-0.086	(0.10)							
N									

Estimates for intial combined transition from: compulsory to university education are not reported here, but available upon request.

Categories for missing parent age and occupation and family income are included.

Normalized APE(Y)=APE(Y) - APE (HUM), for Y=(SOC, NAT, HEAL).

*, **, *** significant on a 10%, 5% and 1% level, respectively.

Model 2 shows that students from families with higher levels of income are more likely to choose health, social, and natural sciences than the humanities. Disciplines like medicine, civil engineering, and economics - economically lucrative fields of study - attracts students from families with lots of economic capital, situating economically well-off parents or parents employed in highly paid jobs in the medical, engineering or hard social science professions, which is line with what Zafira (2012) finds. Students of higher educated fathers and mothers are more likely to choose health sciences than the humanities, which again stresses the importance of academic education of the parents. Males are more likely than females to choose social and natural sciences than the humanities and health sciences (Barone 2011).

Our model 3 shows that the selection into health sciences is very clear. Mothers' education is still very important, in particular in the choice of elite health programs, but

also in the humanities, and social sciences. Likewise, father's education is important in explaining the choice of health programs, natural sciences and to some degree also the social sciences. Strikingly, males are more likely to choose elite humanities than females, lifted up by mothers in higher professions, whereas females are more likely to choose elite social sciences. Students living in urban areas are more likely to enter elite universities. Family income of the parents still plays a part in choosing elite social sciences.

Students of parents with better qualifications have a greater chance of studying at university. However, we should be cautious about drawing conclusions based these models alone; the literature on the role played by mothers' is inconclusive (Holmlund, Lindahl, and Plug 2011).[3]

Table 3: Model 3 – Elite vs. Field of Study, MTMU

2nd stage - Elite institution (Ref.: Non-elite within same field)	Logit coefficients (t-values)				APE			
	Hummanities	Social Sc.	Natural Sc.	Health Sc.	Hummanities	Social Sc.	Natural Sc.	Health Sc.
Female	-0.231** (-2.46)	0.298*** (4.04)	-0.064 (-0.65)	0.257 (1.27)	-0.099	0.063	-0.018	0.034
Non western Immigrant	0.129 (0.55)	0.056 (0.27)	0.314 (1.01)	-0.335 (-0.93)	0.005	0.011	0.009	-0.038
Urban (Copenhagen and Aarhus)	0.567*** (5.70)	0.826*** (9.72)	1.012*** (8.91)	0.648*** (3.53)	0.023	0.185	0.028	0.096
Mothers age	0.009 (0.85)	0.004 (0.44)	0.042*** (3.17)	-0.033 (-1.55)	0.000	0.001	0.000	-0.005
Fathers age	0.033*** (2.66)	0.009 (0.79)	-0.013 (-0.84)	0.035 (1.38)	0.001	0.001	0.000	0.005
Nuclear family	0.157 (1.15)	-0.160 (-1.33)	-0.433** (-2.53)	0.026 (0.09)	0.007	-0.032	-0.012	0.003
Family income (100.000 DKK)	-0.221 (-1.05)	0.704*** (3.65)	0.280 (1.17)	0.569 (1.36)	-0.009	0.101	0.000	0.081
Fathers occupation (ref: Unskilled workers)								
- Skilled workers	-0.355* (-1.88)	0.094 (0.54)	-0.296 (-1.27)	-0.142 (-0.38)	-0.015	0.019	-0.009	-0.010
- Sales & Service	0.029 (0.14)	0.064 (0.35)	0.451* (1.77)	0.497 (1.18)	0.001	0.013	0.013	0.042
- Technicians and associate professionals	-0.002 (-0.01)	-0.290 (-1.32)	0.265 (0.96)	-0.745* (-1.65)	0.000	-0.055	0.008	-0.042
- Professionals	0.190 (0.91)	0.268 (1.47)	0.167 (0.67)	0.112 (0.27)	0.008	0.055	0.005	0.008
- Managers, legislators and senior officials	-0.149 (-0.69)	0.148 (0.77)	0.117 (0.44)	-0.052 (-0.12)	-0.006	0.030	0.003	-0.004
Mothers occupation (ref: Unskilled workers)								
- Skilled workers	0.201 (0.65)	-0.461 (-1.63)	-0.042 (-0.11)	0.912 (1.15)	0.009	-0.088	-0.001	0.142
- Sales & Service	0.266 (1.26)	-0.253 (-1.24)	-0.005 (-0.02)	0.428 (0.90)	-0.006	-0.050	-0.001	0.060
- Technicians and associate professionals	0.566** (2.38)	-0.347 (-1.54)	0.226 (0.86)	0.223 (0.44)	0.004	-0.068	0.006	0.030
- Professionals	0.814*** (3.30)	-0.144 (-0.64)	0.250 (0.93)	0.953* (1.82)	0.009	-0.029	0.007	0.150
- Managers, legislators and senior officials	0.321 (1.09)	-0.077 (-0.29)	0.501 (1.36)	0.373 (0.59)	0.011	-0.155	0.014	0.052
Fathers education (ref: Compulsory education)								
- High school (gymnasium)	0.028 (0.13)	0.294 (1.56)	0.891*** (3.16)	0.627 (1.37)	0.001	0.063	0.024	0.093
- Vocational education	0.125 (0.92)	0.068 (0.55)	0.183 (1.06)	0.009 (0.03)	0.005	0.014	0.005	0.001
- Short/medium higher education	-0.246 (-1.59)	0.196 (1.44)	0.323* (1.71)	0.452 (1.45)	-0.010	0.041	0.009	0.064
- Long higher education	0.086 (0.44)	0.425* (2.55)	0.647*** (2.88)	0.698* (1.76)	0.004	0.091	0.018	0.105
Mothers education (ref: Compulsory education)								
- High school (gymnasium)	0.215 (1.00)	0.144 (0.74)	0.190 (0.72)	0.220 (0.50)	0.009	0.030	0.005	0.029
- Vocational education	0.085 (0.63)	0.074 (0.62)	-0.122 (-0.75)	0.511* (1.66)	0.004	0.015	-0.003	0.073
- Short/medium higher education	0.149 (0.98)	0.215 (1.58)	-0.350* (-1.94)	0.535 (1.62)	0.006	0.025	-0.010	0.077
- Long higher education	0.423* (1.76)	0.473** (2.38)	-0.209 (-0.82)	1.041** (2.23)	0.175	0.102	-0.006	0.168
Constant	-10.497 (-0.21)	-0.860 (-1.02)	0.120 (1.21)	-2.089** (-2.24)	-	-	-	-
u2	10.737 (0.22)	1.103 (1.29)	22.724 (0.01)		-	-	-	-
a	-1.497*** (-13.48)	-1.350*** (-14.63)	1.920*** (15.49)	2.462*** (11.14)	-	-	-	-
N	52733							

Estimates for the initial transitions from compulsory to each field of study are not reported here, but available upon request.

***, **, * significant on a 1%, 5% and 10% level, respectively.

Categories for missing parent age and occupation and family income are included.

CONCLUSION

Our study offers multinomial latent transition analyzes of three major models of selections into the level of university, elite university, and field of study. We show how selection is alive at the later stage given the first and second stages, so we contribute to the study of how social selectivity creates differences in access to elite universities and

19

fields of study *within* the tertiary level; that is how access to higher education is horizontally stratified also when taking into account vertical stratification.

REFERENCES

Alon, S. 2009. "The evolution of class inequality in higher education: competition, exclusion and adaptation." *American Sociological Review* 74: 731–755.

Beller, E. 2009. "Bringing Intergenerational Social Mobility Research into the Twenty-first Century: Why Mothers Matter." *American Sociological Review* 74(4): 507-528.

Barone, C. 2011. "Some Things Never Change." *Sociology of Education* 84(2): 157-176.

Bartus, T. 2005. "Estimation of marginal effects using mergeff." *The Stata Journal* 5(3): 309-329.

Benjaminsen, L. 2006. *Chanceulighed i Danmark i det 20. århundrede. Udviklingen i intergenerationelle uddannelses- og erhvervschancer* [Inequality of opportunity in Denmark in the 20th century] (Vol. 39). Copenhagen: Deparment of Sociology.

Boliver, V. 2011. "Expansion, differentiation, and the persistence of social class inequalities in British higher education." *Higher Education* 61(3): 229-242.

Boudon, R. 1974. *Education, opportunity and social inequality. Changing prospects in Western society*. New York: John Wiley and Sons.

Bourdieu, P. 1986. "The Forms of Capital." pp. 241-258 in *Handbook of Theory and Research for the Sociology of Education,* edited by J. G. Richardson. New York: Greenwood Press

Bourdieu, P. 1996. *The state nobility: Elite schools in the field of power.* Cambridge: Polity Press.

Breen, R., and J.H. Goldthorpe. 1997. "Explaining Educational Differentials: Towards a Formal Rational Action Theory*." Rationality and Society* 9(3): 275-305.

Brint, S., J. and Karabel. 1989. *The diverted dream: Community colleges and the promise of educational opportunity in America, 1900-1985.* Oxford: Oxford University Press.

Cramer, J. S. 2007. "Roboustness of logit analysis: unobserved heterogeneity and mis-specified disturbances." *Oxford Bulletin of Economics and Statistics* 69 (4): 545-555.

Davies, S., and N. Guppy. 1997. "Fields of Study, College Selectivity, and Student Inequalities in Higher Education." *Social Forces,* 75(4): 1417-1438.

Espenshade, T. J., and A. W. Radford. 2009. *No Longer Separate, Not Yet Equal: Race and Class in Elite College Admission and Campus Life.* Princeton University Press: Princeton, NJ.

Gerber, T. P., and S. Y. Cheung. 2008. "Horizontal Stratification in Post-secondary Education: Forms, Explanations, and Implications." *Annual Review of Sociology* 34(1): 299-318.

Grodsky, E., and E. Jackson. 2009. "Social Stratification in Higher Education." *Teachers College Record* 111(10): 2347-2384.

Hällsten, M. 2010. "The Structure of Educational Decision-Making and Consequences for Inequality: A Swedish Test Case." *American Journal of Sociology* 116: 806-54.

Holmlund, H., M. Lindahl, and E. Plug. 2011. "The Causal Effect of Parents. Schooling on Children's Schooling: A Comparison of Estimation Methods." *Journal of Economic Literature* 49 (3): 615-651.

Jackson, M., R. Luijkx, R. Pollak, L.-A. Vallet, and H. G. van de Werfhorst. 2008. "Educational Fields of Study and the Intergenerational Mobility Process in Comparative Perspective." *International Journal of Comparative Sociology* 49(4-5): 369-388.

Jackson, M. 2013. (ed.) *Determined to Succeed? Performance versus Choice in Educational Attainment*. Stanford: Stanford University Press.

Jæger, M. M. 2009. "Equal Access but Unequal Outcomes: Cultural Capital and Educational Choice in a Meritocratic Society." *Social Forces* 87(4): 1943-1971.

Karabel, J. 2005. *The Chosen: The Hidden History of Admission and Exclusion at Harvard, Yale and Princeton.* New York: Houghton Mifflin.

Karen, D. 2002. "Changes in Access to Higher Education in the United States: 1980-1992." *Sociology of Education* 75(3): 191-210.

Karlson, K.B. 2011. "Multiple paths in educational transitions: A multinomial transition model with unobserved heterogeneity." *Research in Social Stratification and Mobility* 29(3): 323-341.

Karlson, K.B., Holm, A., and R. Breen. 2012. "Comparing regression coefficients between same-sample nested models using logit and probit: a new method." *Sociological Methodology* 43: 286-313.

Mare, R. D., and V. Maralani. 2006. "The Intergenerational Effects of Changes in Women's Educational Attainments." *American Sociological Review* 71(4): 542-564.

Mood, C. 2010. "Logistic regression: why we cannot do what we think we can do, and what we can do about it". *European Sociological Review* 26(1): 67-82.

McIntosh, J., and M. D. Munk 2007. "Scholastic ability vs. family background in educational success: evidence from Danish sample survey data." *Journal of Population Economics* 20 (1): 101-120.

McIntosh, J., and M. D. Munk 2013. "An Explanation of Intergenerational Educational Mobility Using the Correlated Mare Model: A Danish Test Case", manuscript.

Munk, M. D. 2014. Social ulighed og uddannelse, in: *Grundbog i Pædagogisk Sociologi*, Copenhagen: Hans Reitzels Forlag: 187-219.

Munk, M. D., P. Poutvaara, and M. Foged 2014: "Social Selection and Occupational Outcomes of Transnational Graduates: UK and US as Magnets", manuscript.

Reimer, D., and R. Pollak. 2010. "Educational Expansion and Its Consequences for Vertical and Horizontal Inequalities in Access to Higher Education in West Germany." *European Sociological Review* 26(4): 415-430.

Shavit, Y., Arum, R., and A. Gamoran. 2007. *Stratification in higher education. A comparative study*. Stanford: Stanford University Press.

Stevens, M. L., E. A. Armstrong, and R. Arum. 2008. "Sieve, Incubator, Temple, Hub: Empirical and Theoretical Advances in the Sociology of Higher Education." *Annual Review of Sociology* 34(1): 127-151.

Triventi, M. 2013."Stratification in Higher Education and Its Relationship with Social Inequality: A Comparative Study of 11 European Countries." *European Sociological Review* 29: 489–502.

Weeden, K. A., and D. B. Grusky. 2005. "The case for a new class map." *American Journal of Sociology* 111(1): 141-212.

Zarifa, D. 2012. "Choosing fields in an expansionary era: Comparing two cohorts of baccalaureate degree-holders in the United States and Canada." *Research in Social Stratification and Mobility* 30(3): 328-351.

[1] We thank Kristian B. Karlson for giving us access to his STATA programs and helpful suggestions in our endeavor to make suitable STATA programs for this paper, Jens Peter Thomsen for sharing insights and suggestions with us, in particular with respect to the literature review (see also Munk and Thomsen 2014: Horizontal Stratification in Access to Danish University Programs by Institution and Field of Study), and participants in the June 2014 seminar organized by Centre for Stratification Research, Copenhagen.

[2] These estimates might be skewed due to potential problems with missing background data on non-western students' parents (leading to an underestimation, for instance, of the educational level of the immigrant parents).

[3] Hovever, studies by Beller (2009) and Mare and Maralani (2006) stress the importance of taking maternal education and occupation into account.