

A dynamic analysis of educational progression:
Comparing children of immigrants
and native Danes

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Abstract

This paper uses a parsimonious version of Cameron and Heckman's (2001) model of educational progression to determine at what stages of their educational careers children of immigrants fall behind their native Danish peers and the magnitude of intergenerational transmission. Two barriers are identified: (1) high dropout rates, particularly from vocational upper secondary educations; and (2) children of Turkish origin have a low entry rate into upper secondary educations. Simulations show that weak socio-economic backgrounds explain the low entry rate but not the high dropout rates. The high dropout rates are thus due to behavioral differences and/or factors not controlled for.

I. Introduction

Migration and integration of ethnic minorities have become key policy issues in many European countries in recent years, including Denmark, where the share of immigrants and their children has increased rapidly over the past decade from 5.1 percent of the total population to 8.2 percent. Projections show that the number of immigrants and their children will almost double over the next 20 years and that the share of ethnic minorities from less developed countries² will increase to 8.7% of the population of working age in 2021 compared to 3.7% today (The Think Tank on Integration in Denmark 2002). This change in population structure is an important social concern because it is well documented that the educational attainment of children of immigrants from less developed countries is lower than that of native Danes

¹ This working paper is based on chapters 2 and 3 of the PhD dissertation "Education and ethnic minorities in Denmark".

² Less developed countries are countries outside of Europe, North America, Japan, Australia and New Zealand. Turkey and Cyprus and parts of the former Soviet Union (Azerbaijan, Uzbekistan, Kazakhstan, Turkmenistan, Kyrgyzstan, Tajikistan, Georgia and Armenia) are also included in the group of less developed countries.

(Hummelgaard et al. 1998, Rosholm et al. 2002, Ministry of Education 2001) and, like many other European countries, attainment of a formal qualifying education is increasingly a prerequisite for employment in Denmark. Hence, without educational attainment equivalent to that of native Danes, the integration of ethnic minorities into economic and social life is difficult.

The concern is exacerbated by the fact that the social welfare system is organized as a redistribution of income by taxation from people currently employed to retired people and other recipients of public transfers, including unemployment benefits, and not as in many other countries as an individual insurance system. Hence the projected change in population structure could put the Danish welfare state under pressure. Furthermore, low educational attainment and consequent high unemployment rates among ethnic minorities may result in geographical and social segregation and eventually ethnic conflict. Already neighborhoods with high concentrations of ethnic minorities and high crime rates exist in the largest cities in Denmark. Therefore, increasing the educational attainment of ethnic minorities, particularly from less developed countries, is one of the most important social goals in Denmark.

In this paper, a parsimonious version of Cameron and Heckman's (2001) dynamic discrete model of educational progression is formulated and estimated. The main objectives are to identify at which stages in the educational system ethnic minority children face barriers to educational progression and to investigate how family background, neighborhood and individual characteristics affect educational choices of native Danes and ethnic minorities.

An extensive literature on educational attainment and the importance of family background exists. With a few exceptions (e.g. Breen and Jonsson 2000, Cameron and Heckman 2001), most previous contributions to the education literature assume that individuals progress through the educational system exclusively in a sequential manner and use simple binary logit or probit models, or the ordered probit model in their analyses. However, many school systems, including the Danish school system, contain parallel branches of study at the upper secondary and tertiary level. Hence students do not only face the decision to continue at the next higher grade level, but also which branch to choose. By modeling this multinomial choice as a binary choice important information is lost. Furthermore, Cameron and Heckman (1998) show that cross sectional models suffer from dynamic selection bias.

The ordered discrete choice model cannot address questions related to choice of path in the school system and even if the outcome of interest were simply the highest education attained, the ordered probit model is inappropriate for the analysis of education in Denmark, particularly for analyses concerning children of immigrants. One reason is that the age distribution of children of immigrants is skewed. Most

are still too young to have completed their educational careers. This implies that inferences based on ordered probit analyses of these cohorts may not be valid. The second reason is that to use the ordered model the structure of the educational system must be sequential so that it is possible to rank educational degrees in ascending order from the lowest to the highest educational attainment level. This is not possible in Denmark because, as will be discussed further below, vocational educations are both an upper secondary education and a qualifying education.

Clearly, a model of educational transitions that takes into account the particular institutional structure is better able to explain why educational choices and attainment differ according to ethnicity, sex, family background, and other exogenous variables. By modeling educational choices as a sequence of multinomial decisions, the Cameron-Heckman model is able to accommodate both the institutional structure of the educational system and to control for dynamic selection bias.

Using Cameron and Heckman's model, the analyses in this paper thus provide more detailed information about the educational choices and consequent attainment of children of immigrants and native Danes than previous studies. Furthermore, a unique comprehensive individual-level data set drawn from administrative registers at Statistics Denmark is used in the analyses undertaken. Information is available for all immigrants and their children and for 10 percent of the native Danish population from 1984 to 2001.

The structure of the paper is as follows: The next section provides background information about the migration history and the educational system in Denmark and the literature on ethnic minorities and educational attainment is reviewed. Section III describes the data, sample characteristics, and the explanatory variables used. The econometric model is discussed in section IV and the results of a descriptive analysis as well as the econometric analyses are presented in section V. Finally, section VI concludes.

II. Background

A. Migration history

Denmark is not a traditional migration country. During the period from the conclusion of the Second World War and up to the end of the 1960s less than one percent of the population migrated.³ Immigrants arrived mainly from Norway, Sweden, Great Britain, Germany, and the USA and largely comprised native Danes returning home after a period of residence abroad. However, immigration changed in both extent and composition towards the end of the 1960s in response to increasing de-

³ Some sections of the historical overview presented draw extensively on Pedersen (1999).

mand for manpower due to high economic growth. In spite of the post-war baby boom and increasing labor participation by women, the available domestic manpower was insufficient to meet demand and, therefore, Denmark started importing manpower, primarily from Turkey, the former Yugoslavia, and somewhat later, also from Pakistan.

Immigration was not to any great extent based on agreements between Danish companies and placement services in the various countries (Andersen (1979) referenced in Pedersen (1999)), though it was occasionally the case. Many of those emigrating from Turkey and Yugoslavia spontaneously chose Denmark as their preferred destination in part due to a slowdown in economic activity in the then West Germany. The dramatic increase in the number of immigrants in search of work resulted in immigration legislation becoming increasingly restrictive up to the oil crisis in autumn 1973. At this time, unemployment rose rapidly resulting in a government decision to introduce an actual ban on all immigration in November 1973. The stoppage, however, did not apply to EEC⁴ citizens or citizens of the other Nordic countries.

However, the number of immigrants from countries outside the Nordic area, the EEC and North America did not decrease as a result of the ban. In fact, the number of nationals from the former Yugoslavia and the number of Pakistanis almost doubled from 1974 to the mid-1990s, while there was a fivefold increase in the number of Turkish citizens. The reasons are, first, that foreign workers from Turkey, the former Yugoslavia and Pakistan were not sent home with the onset of the oil crisis. Instead they were gradually awarded permanent residence and work permits. The general attitude at the time was that, having invited foreign workers to come to Denmark one could not just deport them when there was insufficient employment opportunities. A second reason is that those guest workers who had been granted permanent residence now brought their wives and children to Denmark in accordance with family immigration legislation. Legislation governing family reunification gave any foreigner with a residence permit the right to bring his or her spouse and any children under 18 into the country. Finally, a sharp increase in the number of refugees is a third reason for the observed development in the number of immigrants from third-party countries.

From the mid-1970s there were two main streams of refugees: 'boat people' from Vietnam after the Communist victory and Chileans fleeing after Pinochet's coup d'état in 1973. In the 1980s, refugees arrived from Iran and Iraq as a result of the war between these two countries. Other refugee groups were stateless Palestinians, Lebanese, and Tamils from Sri Lanka. In the 1990s, refugees have included state-

⁴ EEC = European Economic Community.

less Palestinians as well as tribal peoples from Somalia and Iraq. The largest refugee group, however, came from Bosnia-Herzegovina, from where in 1995 alone, Denmark granted permanent residence permits to 16,185 people, a figure that constitutes a good 20 percent of all the refugees who came to Denmark during the period 1956-95.

New legislation came into force on January 1, 1999. The municipalities were made responsible for offering all adult immigrants who arrived in Denmark after this date a so-called introduction programme. The content and duration of the introduction programme depend on the immigrant's qualifications but it usually includes Danish lessons and job training and lasts for up to three years. Participation in the programme is mandatory. The new legislation also introduced quotas for geographical placement of refugees. To combat the emerging ghettos, newly arrived refugees were allocated housing in municipalities with few ethnic minority residents and were obliged to live in the allocated municipality for the duration of their introduction programme.

A comprehensive reform of the Aliens Act was undertaken in 2002. Since then, numerous amendments have been made. The new act and the subsequent amendments have been criticized for the many restrictions introduced in particular for refugees and asylum-seekers and for the rules regarding family reunification (see for example Commissioner for Human Rights Gil-Robles' report on his visit to Denmark, 2004). According to the current family reunification legislation a residence permit will only be granted to a foreign spouse on the basis of marriage or cohabitation if both parties are over 24 years of age. Until they have both reached this age, and even if one of them is a Danish citizen, they can only hope for family reunion in Denmark under exceptional circumstances. There are also a number of economic requirements for the reunification of spouses,⁵ and a requirement that the spouses' or cohabitants' aggregate ties with Denmark are stronger than their aggregate ties with another country. Until 2002, parents over 60 years of age could be reunited with their families in Denmark. This right was abolished under the reform. The eligibility conditions for family reunification were further restricted with a 2004 amendment reducing the age limit allowing reunification of children from under-18 to under-15. Following the tightening of the legislation, the number of new arrivals in Denmark has declined markedly.

⁵ In addition to being able to financially maintain the spouse in Denmark, the Act requires that the person living in Denmark has not received social assistance for a period of one year prior to applying for family reunification, possesses a dwelling of a reasonable size, and provides a bank guarantee of DKK 50,000 to cover any future public expenses for any social assistance granted to the applicant (1 USD = 7 DKK).

B. The Danish educational system

The Danish educational system is predominantly a public system. It consists of nine years of compulsory grade school, followed by an optional 10th year of grade school, upper secondary school, and finally advanced educations (see figure 1). The upper secondary level is divided into one vocational and one academic track. Academic upper secondary schools qualify the student for entry into advanced educations at the tertiary level, but do not qualify the student for any particular job category. Qualifying educations that provide the student with formal qualifications of direct use in the labor market thus include vocational upper secondary educations and advanced educations.

To comply with the nine years of compulsory education, about 86 percent of children in Denmark attend public schools and the remaining 14 percent attend private schools. Public grade schools are comprehensive schools managed by the municipalities. Following the Danish constitution, there is no tuition fee in public schools and books are free. The share of children attending private schools has been increasing over the past few years. These schools are heavily subsidized by the state, which finances about 80 percent of their total costs.

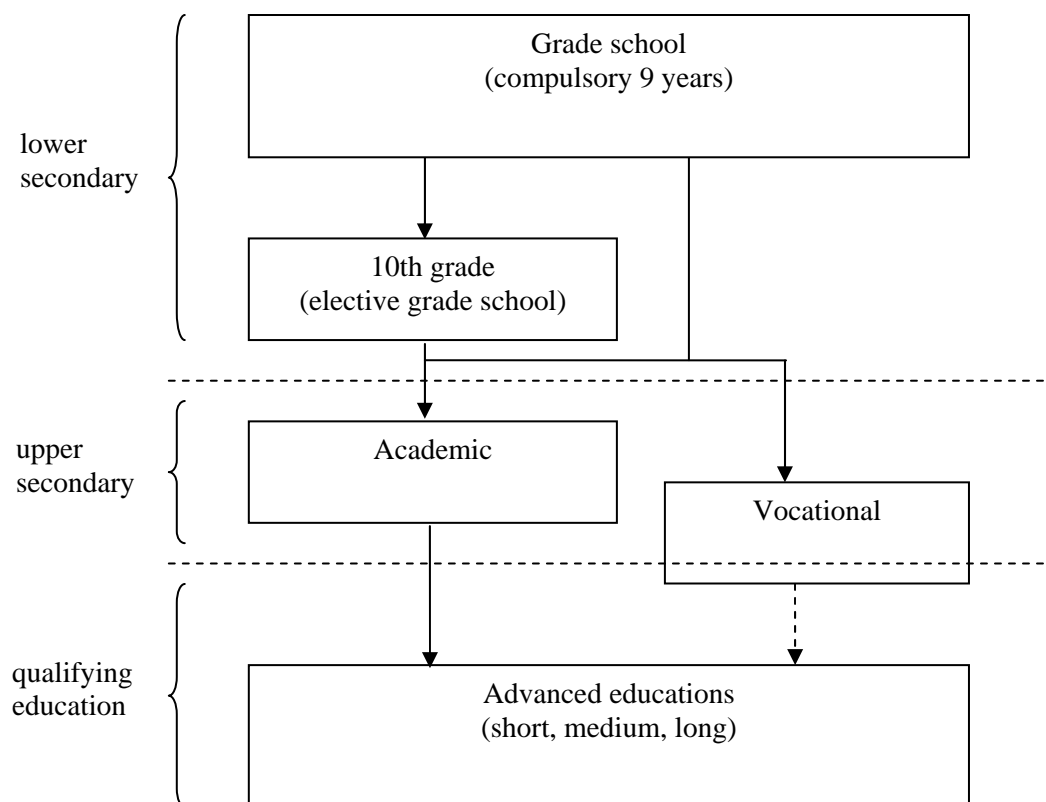


Figure 1
The Danish Educational System

There are approximately 85 different vocational upper secondary educations, ranging from clerical education to training in such skills as carpentry, plumbing and car mechanics. These educations consist partly of time spent at vocational schools and partly of an apprenticeship with an employer and take between two to four years. Vocational upper secondary educations are financed and managed by the state whereas some academic upper secondary educations are financed and managed by the counties and others are financed and managed by the state.⁶

Tertiary level educations are usually divided into three groups according to the duration of the education. Short advanced degrees take one to three years and typically aim at a specific field such as technicians, engineers and computer scientists. Medium advanced degrees take three to four years and cover a great variety of professions, including grade school teachers, nurses, journalists and social workers. Long advanced degrees take five to six years and are research based degrees undertaken at universities. With a few exceptions admission to advanced educations is restricted to students who have completed an academic upper secondary education and depends on the student's grade point average.⁷ Most advanced educations are financed by the state, but the universities enjoy a high degree of autonomy, particularly with regard to the contents of the programs. Tuition in advanced education is free.

In addition to the educations described above are the Civil Service educations such as the police, the national transportation service and the national mail service. Furthermore, educations within the armed forces and in the private sector such as banking, insurance and shipping can be pursued.

Previously, there was a sharp divide between the branches of the educational system. Only a small proportion of children, primarily those with university educated parents, went to academic upper secondary schools and subsequently pursued a university degree. Over the past 30 years, however, academic upper secondary schools have become more accessible and consequently a larger share of the population now chooses an academic upper secondary education over vocational and other educations.

One reason academic studies have become more accessible is that the state has to a large extent taken over the financial responsibility for students above the legal age of 18. The fundamental principle is that everyone 18 years of age and older is entitled to economic support from the government if she/he attends an eligible educational program and is personally eligible. The support is provided by the State Edu-

⁶ A few private high schools exist in Denmark. These are highly subsidized by the state, which finances nearly 90% of their costs.

⁷ For example, one exception is that a few vocational upper secondary educations qualify the student to pursue selected engineering programs.

cational Grants and Loans Scheme, managed by the Danish Students' Grant and Loans. The grant is sufficient to cover living expenses and study related expenses, including books. The grants and loans scheme is the only source of economic support of any significance for students in Denmark, as universities and other education institutions play no direct role in the financial support of students, and parental support is limited.

In 2001, 298,100 students received student grants, of these 116,500 attended upper secondary educations while 181,600 were enrolled in advanced educations. The total amount disbursed was DKK 10.5 billion⁸ which accounted for 0.77 percent of Denmark's GDP.

C. Prior literature

Haveman and Wolfe (1995) review the extensive US literature on educational attainment and the importance of family background. One of their conclusions is that when family background and parental choices are controlled for, being a racial minority does not appear to have a negative effect on schooling. However, most of the studies reviewed control for ethnic differences only by including dummy variables for race. Cameron and Heckman (2001) explicitly investigate differences in educational attainment of White, Hispanic and Black males in the US. They find that controlling for family background, minorities are more likely than Whites to graduate from high school and attend college.

A few studies of educational attainment of ethnic minorities in Denmark (Rosholm et al. 2002, Skyt Nielsen et al. 2003) and a few other European countries (Gang and Zimmermann 2000, Riphahn 2003, Österberg 2000, van Ours and Veenman 2003) exist. Both Danish studies focus exclusively on children of immigrants who by definition are born in Denmark to immigrant parents.⁹ A common finding in the two studies is that children of immigrants are less likely to complete a qualifying education compared to native Danes but the results on the relative magnitude of intergenerational mobility conflict. Rosholm et al. (2002) use an ordered probit model and conclude that the magnitude of intergenerational mobility is the same for children of immigrants from less developed countries and native Danish youth. An undesirable result they conclude because ethnic minority children generally come from more disadvantaged backgrounds and it would thus be beneficial if their intergenerational

⁸ This amount is equivalent to about 1.4 billion US\$.

⁹ According to Statistics Denmark, *immigrants* are individuals born outside Denmark, whose parents are both foreigners or born outside Denmark. An individual born outside Denmark for whom only one parent is known and the other is not a native Dane is also defined as an immigrant. Finally, if both parents are unknown and the individual is born abroad he or she is also defined as an immigrant. *Children of immigrants* are individuals born in Denmark to parents who either are immigrants or children of immigrants themselves. Individuals born in Denmark for whom only one parent is known and the other is not a native Dane are also defined as children of immigrants. Finally, if both parents are unknown and the individual is born in Denmark and is a foreign citizen he or she is also defined as a child of an immigrant.

mobility was greater than the one of native Danes. In contrast, Skyt Nielsen et al. (2003), using simple cross sectional logit models to analyze whether individuals have completed a qualifying education by 1997 or not, conclude that intergenerational mobility is larger for children of immigrants than for native Danish youth.

Two other quantitative studies have investigated dropout decisions from qualifying educations among a sample of immigrants in Denmark. Jakobsen and Smith (2003) find that inadequate Danish language proficiency significantly affects the probability of dropping out, but they find no significant effects of parental background variables. They use a binary probit model without controlling for dynamic selection bias and therefore point out that their findings must be taken with reservations. However, using a competing risk duration model controlling for sample selection and unobserved heterogeneity to analyze the time patterns of dropout rates Jakobsen and Rosholm (2003) do not find significant effects of parental background variables on dropout rates either.

III. Data

In 1968, social security numbers were introduced in Denmark and since then a large number of public authorities and public and private institutions and organizations have submitted individual level data to Statistics Denmark. The two panel data sets used in this paper draw on this wealth of information. One is a census of all immigrants and their children, the other is a 10 percent random sample of the entire Danish population aged 15 and above. Both the census and the 10 percent sample are updated annually and currently cover the period 1984-2001. Information is available on a wide variety of topics, including demography, housing and change of address, labor market attachment, educational enrollment and attainment, income and wealth, social benefits, and health. The analytical unit in both data sets is the individual and not the household but for ethnic minorities, household information can readily be computed from the census.¹⁰ For native Danes, parental information is available in a separate data set for selected cohorts of children.

Unlike survey data, administrative data from statistical registers are not susceptible to errors in reporting due to memory issues, self presentation concerns or comprehension. Another advantage is that attrition only occurs at death or emigration. On the downside, however, administrative data do not provide the kind of information available from clarifying behavioral questions in surveys such as reasons for dropping out of school, Danish language proficiency, religious affiliation, and expectations and ambitions. Unfortunately, information about a student's grade point average from grade school is not available either.

¹⁰ However, information about family members who have not resided in Denmark from 1984 to 2001 is not available.

A. Sample characteristics

The analyses in this paper focus on children of immigrants¹¹ from so-called less developed countries¹² and children of native Danes because both ethnic groups spend most of their childhood in Denmark and thus attend Danish grade school which should provide similar prerequisites in terms of educational preparedness and Danish language proficiency necessary for further educational progression. Previous descriptive analyses (Ministry of Education 2001, Hummelgaard et al. 1998) suggest that educational attainment vary greatly by country of origin. Therefore, separate analyses are also undertaken for children from the two largest ethnic minority groups; the Turks and the Pakistanis, for whom the sample sizes are large enough for separate statistical analyses of educational progression.

The samples used for native Danes and children of immigrants include children from age 15 and as long as they are present in the data. The population of children of immigrants is very young. In 2000, the total number of children of immigrants of Turkish and Pakistani descent was 19,734 and 7,567, respectively. About 80 percent of the Turks and 65 percent of the Pakistanis were 15 years or younger and almost no children were above the age of 25. Consequently, it is not possible to follow all individuals to age 30 when most people have completed their qualifying education. The sample is unbalanced. The fact that many individuals' educational careers are censored must be taken into account when modeling their educational choices as further discussed below.

The samples have been reduced in the following ways. First, only children who are enrolled in grade school at age 15 are included because it is important for the analysis of subsequent educational decisions at the upper secondary level to model the path leading up to the decision.¹³ Second, children who are not present in the data set in two or more consecutive years are only included in the analysis up until the year they leave the data set, even if information is available for later years. The reason is that information about the individual's educational behavior abroad is not available in the data and it is thus not possible to analyze her/his educational progression.¹⁴ If the individual is only away one year, it is assumed that the educational attainment is the same upon her/his return as the year before she/he left. Third, the individual has to be present in the data at least two years after completion of grade

¹¹ See footnote 9 for details.

¹² See footnote 2 for details.

¹³ 9th grade is the modal grade to be enrolled in at age 15. The share of children who have already started an upper secondary education at age 15 is 2 percent for native Danes, less than 1 percent for the Turks, 4 percent for the Pakistanis, and 3.4 percent for the children of immigrants in the aggregate. In addition, 2 percent of the native Danes did not have information about educational enrollment at age 15. These individuals were also dropped from the analysis as were the 6.4, 8.1 and 6.7 percent of the Turks, the Pakistanis and the children of immigrants in the aggregate without educational information at age 15, respectively.

¹⁴ A total of 7 Pakistanis, 2 Turks, 212 children of immigrants in the aggregate and 1,188 native Danes are affected by this restriction.

school to be included in the analyses as discussed in section IV.¹⁵ Finally, although information is available on 10 percent of the native Danish population, only two percent were used in the statistical analyses to reduce computational costs.

B. Explanatory variables

Economic theory provides some insights into the factors determining educational attainment of children. These may be summarized as parental income and preferences, family size and composition, endowments, and the returns to and cost of human capital investment (Becker and Lewis 1973, Becker and Tomes 1986, Behrman et al. 1982). In addition, more recent contributions point to a number of additional factors of importance for immigrants, namely; ethnic capital, neighborhood characteristics, language proficiency, country of origin, age at immigration, and duration of stay in the host country (Borjas 1995, Chiswick and DebBurman 2004). However, theory does not provide any indication of suitable measures of the determinants. Consequently, the purpose of the study, data availability, the statistical model chosen, previous empirical findings, and common sense to a large extent dictate the empirical specification of models estimated in the literature.

Table 1 presents the means and standard deviations of the explanatory variables used in the statistical analyses in this paper. Most of the variables are computed the year the child was 15 years old which is the first year data are available for native Danes and parental background variables are included separately for the mother and the father to account for assortative mating. The table shows that parental background characteristics are more favorable for native Danes. The average number of years of schooling of Danish mothers and fathers is 11 and 12 years, respectively, compared to only 5 and 7.5 years for the Turks. The table also shows that the income level of both parents is much higher for native Danes.

¹⁵ Hence students who leave grade school in 2000 and 2001 are not included.

Table 1*Means and standard deviations of explanatory variables by ethnic group*

	Children of immigrants (N=7,216)		Pakistanis (N=1,412)		Turks (N=1,664)		Native Danes (N=15,883)	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
Mother's characteristics								
Educational attainment (years)*	7.69	4.79	7.82	4.49	5.31	4.20	11.06	3.11
Missing educational information (%)	65.15	-	65.16	-	70.79	-	2.65	-
Gross income (DKK)**	130,204	73,575	110,277	79,423	129,111	60,478	178,151	100,633
Work experience (years)	4.90	4.56	3.72	3.49	4.90	3.53	10.41	6.71
Duration of stay in Denmark (years)	17.79	4.61	17.00	4.25	17.17	4.11	-	-
Mother missing (%)	1.77	-	1.70	-	1.32	-	1.43	-
Father's characteristics								
Educational attainment (years)*	9.64	3.92	10.21	3.29	7.54	3.65	11.90	3.34
Missing educational information (%)	58.37	-	54.89	-	64.60	-	7.69	-
Gross income (DKK)**	180,894	122,471	170,732	102,700	162,403	86,395	314,468	304,445
Work experience (years)	10.94	6.29	11.15	5.88	10.99	5.32	15.56	8.39
Duration of stay in Denmark (years)	19.97	4.78	18.98	3.20	19.36	4.15	-	-
Father missing (%)	5.61	-	5.45	-	2.94	-	5.93	-
Family structure								
Nuclear family (%)	82.95	37.61	87.18	33.44	87.44	33.15	70.86	45.44
Number of siblings (#)	3.93	1.56	4.40	1.44	3.78	1.36	2.42	1.02
Neighborhood								
Child lived in disadvantaged neighborhood at age 15 (%)	14.20	34.91	11.54	31.97	17.43	37.95	1.27	11.21
Share of minorities in 9 th grade (%)	22.45	22.63	22.66	22.57	16.80	17.43	1.70	4.69
Missing information about grade school (%)	1.59	-	1.49	-	0.30	-	8.30	-
Characteristics of child								
Female (%)	48.88	49.99	45.40	49.81	48.80	50.00	48.65	49.98
Age of child when leaving grade school (years)	16.72	0.66	16.83	0.71	16.83	0.65	16.71	0.59
Change of branch of education (%)								
- from academic to vocational	4.04	-	3.54	-	4.03	-	2.77	-
- from vocational to academic	17.15	-	20.08	-	11.63	-	4.01	-

* Parents with missing educational information are excluded from the computation of the means and standard deviations of educational attainment.

** 1 US\$ = 7 DKK. The explanatory variables for gross income included in the analyses are log (gross income of mother) and log(gross income of father).

Parental educational attainment is included in the analyses as a measure of endowments. The correlation between parental and child education is likely to be positive because of genetics and possibly also because of ‘cultural transmission’; more highly educated parents may provide a better environment, e.g. books around the house and help with homework, for producing human capital in their children. In addition, schooling attainment of parents may affect the educational preferences they have for their children and the cost of education.¹⁶

The number of years of education attained by parents is included in the analyses. Alternative specifications were investigated, in which dummy variables indicating attainment levels were computed to take into account the possible nonlinearity of education effects. However, as discussed below, the continuous specification was preferred due to the econometric model used.

As is evident in the table, parental educational information is missing for 50-70% of the children of immigrants. The reason is that only information about education obtained in Denmark is available in the register data used. A survey was conducted in 1999 to collect information about immigrants’ education from their home countries to replace the missing educational data.¹⁷ The response rate was very low. Unfortunately, the response rate was particularly low for immigrants from Turkey (30.1 percent) and Pakistan (38.8 percent). Statistics Denmark has imputed the values for the people who did not reply based on country of origin, age at immigration, current age, and sex. Since most of these variables are used either directly or indirectly as explanatory variables in the statistical analyses, imputed values of educational attainment are not used to avoid collinearity. Instead dummy variables are included to control for the effect of missing parental educational information.

Parental income is included in the analyses as a measure of the economic resources devoted to the child. Income is specified as the logarithm of gross income the year the child was 15 years old measured in 1990 prices. The expectation is that parents with higher incomes have children with higher educational attainment.¹⁸ In many empirical studies this relationship is interpreted as evidence that short-term liquidity constraints affect schooling choices. However, as discussed by Cameron and Heckman (1998:306) family income measured in a cross section may represent ei-

¹⁶ See Ermisch and Francesconi (2001) and Ejrnæs and Pörtner (2002) for a discussion of the relationship between parental education and the cost of education and the cost of a child, respectively.

¹⁷ A total of 152,181 immigrants received the questionnaire, of which 49.7 percent returned valid replies. The questionnaire was sent to people who on January 1, 1999 were 18-59 years old, were 16 years or older when they immigrated to Denmark, and who did not have a qualifying education from a Danish educational institution.

¹⁸ Although some argue that a high income may have adverse effects on children’s educational attainment if parents work long hours and spend little time with their children.

ther short-run resources available to the family or more permanent family influences such as permanent income and genetic endowments, including ability. Information about ability is rarely available in data sets and it is also not available here. Consequently, although the analyses undertaken here control for unobserved heterogeneity, reflecting in part ability, the estimated income effects may be biased.

Duration of stay and work experience of parents are included as measures of endowments. Preferably, information about parental Danish language proficiency and their knowledge of the workings of the educational system as well as the importance of education for future employment opportunities should be included in the analyses. However, these variables are not available in the data set. Therefore, the duration of stay in Denmark at the time the child is 15 years old is included as a proxy. However, not only the duration of stay but also how that time is spent is assumed to be important. Parental work experience in Denmark is, therefore, also included because, *ceteris paribus*, parents with stronger labor market attachment are expected to be better integrated in social and economic life and have better Danish language skills which enables them to help their children better with their homework. Hence parents who have spent more time in Denmark and parents who have more work experience will provide a better environment for producing human capital in their children.

The Turkish and the Pakistani mothers and fathers have on average spent 17 and 19 years in Denmark, respectively. However, the work experience of the mothers is only 4-5 years compared to 10 years for native Danish mothers. The difference in work experience between ethnic minorities and native Danes is smaller among fathers. If mothers, as is often assumed in the literature, are particularly important for the educational attainment of their children, the low labor market participation of ethnic minority women may be an important social problem not only in the short run, but also in the long run.

Experience is clearly measured with error to the extent people work in the informal sector but it seems reasonable to assume that work experience in the informal sector has a smaller positive effect on education of children than work experience in the formal sector. Considering the poor quality of the parental education variable, work experience may also capture the effect of education if, for example, better educated parents are more likely to be employed.

Two variables controlling for family structure are included in the analyses; one is whether the child lived with both biological parents at age 15, the other is the number of children in the family. The table shows that the share of native Danish children who live with both biological parents is much smaller than is the case among ethnic minorities and that the average sibship size is larger among ethnic minorities.

Previous studies have shown that growing up in a one parent family or experiencing divorce or marital separation is negatively related to the level of schooling attained. This may be interpreted as a causal effect or the variable for broken home may be a proxy for an unfavorable home environment (see Björklund et al. 2004b for a review). Empirical evidence is also strong that family size matters. Different hypotheses have been put forth in the literature as to why sibship size affects children's outcomes.

Economic theory suggests that parents may trade off quantity and quality of children (Becker and Lewis 1973). Parents who want their children to go far in the educational system may choose to have fewer children to be able to invest more in the ones they have, in which case, the number of children is endogenously determined by parents who take into account their budget constraint, the genetic endowments of existing children and their expectations about the genetic endowments of possible future children. In this paper, the analyses are undertaken conditioning on the structure of the household when the child was 15 years old. Consequently, the estimate on number of siblings may be upwardly biased.

Variables for neighborhood effects are included in the analyses because economic theory dictates that the environment in which the child grows up is part of the child's endowments. However, as noted by Evans et al. (1992), it is by no means clear, whether the group with the most influence on an individual's behavior is the community in which the person resides, those in the school the person attends, or a select group of close friends.

Municipalities is the smallest geographical unit of analysis available in the data used but are clearly not a very good measure of neighborhood as they vary in size and most municipalities contain very different residential areas. In this paper, two neighborhood indicators are used. The first variable indicates whether the child lived in a disadvantaged neighborhood at age 15.¹⁹ Housing projects are ranked by an index computed from a number of indicators of socioeconomic status, including the share of residents that are ethnic minorities, the unemployment rate, the share of residents who receive early-retirement benefits, the share of single-parent households, and the average disposable income. Disadvantaged neighborhoods are defined as the 20 percent of the housing projects that score worst on the index. Almost 12 percent of the Pakistanis and 17 percent of the Turks live in disadvantaged neighborhoods compared to about one percent of the native Danes.

Ginther et al. (2000) conclude that the more closely the neighborhood variable is tied to the outcome under study the more likely the variable is to be significant, and

¹⁹ This variable was computed in a previous research project, see Hummelgaard et al. (1997) for details.

remain significant as the number of family background variables is increased. Therefore, the other measure used is the share of ethnic minorities in the 9th grade classes at the child's school. The average share of ethnic minorities in 9th grade is over 22 percent for Pakistanis, almost 17 percent for Turks and only about two percent for native Danes.

Also the estimates of neighborhood effects are possibly biased. Bias may arise because families are not randomly placed in neighborhoods but rather choose their location based on an assortment of factors, including the importance they place on their children's education and future earnings. The direction of the bias is related to the way the unobservables associated with neighborhood selection are correlated with the unobservables associated with children's outcomes. It is generally thought that this bias is positive, reflecting the potential of attributing family characteristics, such as parental competence, taste for education, or time spent with their children, to the neighborhood measures. How to empirically solve the selection problem remains unsettled and is not addressed in this paper.

Unfortunately, information about the child's grade point average from grade school is not available for the cohorts of children under study. However, the variable for the concentration of ethnic minorities in 9th grade may also partly control for academic preparedness. The assumption is that the higher the concentration of ethnic minorities in school, the more likely children of immigrants are to associate with peers in the language of their home country and the weaker Danish language proficiency they are likely to have which negatively affects learning. In addition, inadequate Danish language proficiency among students will negatively affect the quality of the instruction and thus their academic preparedness.

Finally, an indicator variable for the sex of the child, an indicator variable for whether or not the child changes branch of upper secondary education, and a time-varying variable for the age of the child are included. Cameron and Heckman (2001) find that age matters for educational choices. The table shows that relatively many Pakistanis change from a vocational upper secondary education to an academic upper secondary education.

In sum, although the data used have some obvious limitations, as discussed above, they are still much more comprehensive in coverage than data used in most other studies of children's educational attainment in which researchers also struggle with concerns about endogeneity due to omitted variables bias, simultaneity bias, and measurement error.

IV. The econometric model

The dynamic discrete choice model formulated and estimated in this paper is based on a model developed by Cameron and Heckman (2001). The point of departure for their work was the recognition that schooling attainment at any age is the outcome of previous schooling decisions and that particularly for minority groups and low-income Whites, high school graduates are select members of the source population, making it particularly important to control for educational selectivity when analyzing causal effects of family background on educational attainment of these groups. Cameron and Heckman (*ibid.*) therefore extend the econometric models previously used in the literature on the economics of schooling attainment analyzing the entire set of age-specific schooling decisions from age 15 through age 24, controlling for unobserved heterogeneity. Their methodology enables them to separate out age-by-age influences of variables such as family income in a general way and they are able to include time-varying explanatory variables. The following presentation of the model is based on the description in Cameron and Heckman (*ibid.*).²⁰

Let age be denoted by i ($i \in \{\underline{i}, \dots, \bar{i}\}$). Schooling choices at i determine schooling levels at age $i+1$. Schooling attainment at age i is $j_i \in J$ (J is a set of possible attainment states over all ages). Individuals with schooling status j_i make their choices about schooling at age $i+1$ from the feasible choice set K_{i,j_i} . Let $D_{i,j_i,k} = 1$ if option $k \in K_{i,j_i}$ is chosen by a person of age i with schooling j_i and $D_{i,j_i,k} = 0$ otherwise. Because only one choice is made, $\sum_{k \in K_{i,j_i}} D_{i,j_i,k} = 1$.

Assume that individuals choose optimally at each age and schooling status j_i , inclusive of the options for further schooling opened up by attaining this educational level. Then the optimal choice at age i denoted by a hat, is

$$\hat{k}_{i,j_i} = \arg \max_{k \in K_{i,j_i}} \{V_{i,j_i,k}\},$$

where $V_{i,j_i,k}$ is the value of option k at age i for a person with j_i years of schooling. Hence $D_{i,j_i,k} = 1$ for $k = \hat{k}_{i,j_i}$ and $D_{i,j_i,k} = 0$ otherwise. The model is fundamentally sequential: the choice set K_{i,j_i} confronting the individual at age i is a consequence of choices made in the previous period. To avoid clutter, henceforth the i subscript on j is dropped and the choice made at age i is referred to as k_i . For computational simplicity $V_{i,j_i,k}$ is approximated using a linear-in-the-parameters form:

²⁰ To simplify the notation, the subscript for individuals is ignored.

$$V_{i,j,k} = Z'_{i,j,k} \beta_{i,j,k} + \varepsilon_{i,j,k}$$

where $Z_{i,j,k}$ is a vector of observed constraint and expectation variables at age i for a person of schooling attainment j , and $\varepsilon_{i,j,k}$ is an unobservable from the point of view of the economic analyst. The unobservable is assumed to be characterized by a factor structure

$$\varepsilon_{i,j,k} = \alpha_{i,j,k} \eta + \gamma_{i,j,k}$$

where η is a mean zero, unit variance random variable.

Two assumptions are made:

ASSUMPTION 1. The random variable η is independent of $\gamma_{i,j,k}$ for all i, j and k . In addition, all η and $\gamma_{i,j,k}$ are independent across people.

ASSUMPTION 2. The term $\gamma_{i,j,k}$ is an extreme value random variable and is independent of all other $\gamma_{i',j'',k''}$ except for $i = i', j = j'',$ and $k = k''$.

Assumptions 1 and 2 produce an extension of McFadden's (1974) conditional logit model. Conditioning on η :

$$\Pr(D_{i,j,k'} = 1 | Z_{i,j}, \eta) = \Pr\left(\arg \max_k V_{i,j,k} = k' | Z_{i,j}, \eta\right) = \frac{\exp(Z'_{i,j,k'} \beta_{i,j,k'} + \alpha_{i,j,k'} \eta)}{\sum_{k \in K_{i,j}} \exp(Z'_{i,j,k} \beta_{i,j,k} + \alpha_{i,j,k} \eta)}$$

where $Z_{i,j}$ is the collection of the $Z_{i,j,k}$ arrayed in a vector. As a consequence of assumption 1, any dependence between $D_{i,j,k}$ and $D_{i',j'',k''}$, $i \neq i'$, for the same person conditional on $Z_{i,j,k}$ and $Z_{i',j'',k''}$ arises from η , the person-specific effect.

The model is estimated making the following additional assumption.

ASSUMPTION 3. The $Z_{i,j,k}$ are independent of η for all $i, j \in K_{i,j}$ and for all choice sets.

This does not imply that the $Z_{i,j,k}$ ($i > \underline{i}$) conditional on past choices are independent of η . In general they are not, so it is necessary to model the history of the process leading up to any transition being analyzed in order to account for the induced con-

ditional endogeneity. Heckman (1981) and Cameron and Heckman (1998) demonstrate how conditioning on the history of the life cycle process corrects for the induced dependence between η and $Z_{i,j,k}$ ($i > \underline{i}$), given the history of previous choices. With these assumptions, the probability of any schooling history can be determined by building up the sequence of age-specific probabilities over the life cycle.

However, the generality of the Cameron-Heckman model specification comes at the cost of potential inefficiency. Therefore, a more parsimonious version of the model, disregarding the age dimension, is formulated in this paper.²¹ The model estimated is depicted in figure 2.

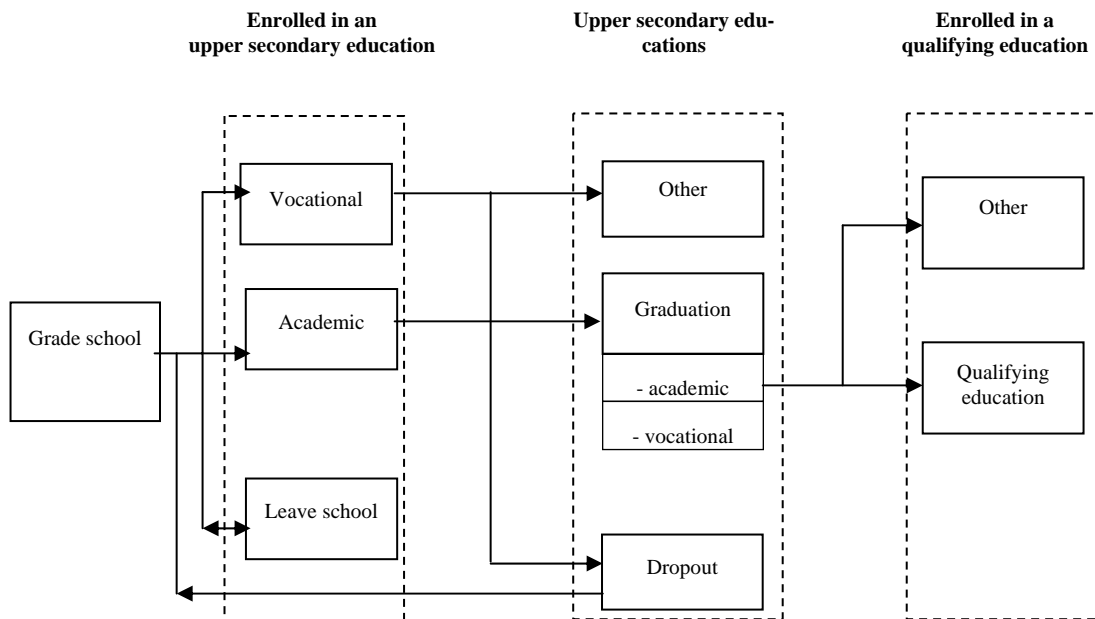


Figure 2
Estimated model of educational progression

Schooling transitions are modeled from an individual completes grade school until she/he either completes a qualifying education at the upper secondary level, i.e. a vocational upper secondary education, or enrolls in a qualifying education upon graduation from an academic upper secondary education. Individuals who complete a vocational upper secondary education have acquired skills that qualify them for

²¹ Breen and Jonsson (2000) apply a similar model of educational transitions from different grade levels to a large Swedish data set.

specific job categories. Therefore, only the decision to start a qualifying education by individuals who complete an academic upper secondary education is modeled. Due to the limited number of ethnic minority youth at this level it is not possible to differentiate between different types of tertiary educations.²²

A. Unobserved heterogeneity

It is unlikely that youths when they leave grade school have the same set of preferences for school, skills, abilities and motivation with respect to school or expectations about the value of education beyond grade school. Although preferences may change, skills may be augmented and expectations altered, the importance of these initial traits may be large and persistent.

These characteristics of the individuals are not observed by the researcher. However, omitting variables that influence educational choices at all transitions from the statistical analysis gives rise to the problem of educational selectivity, or dynamic selection bias. The reasons are that the distribution of the unmeasured traits shifts to the right across successive transitions, as persons with lower values of the traits leave the school system and hence drop out of the sample, which becomes unrepresentative of the population. Secondly, the traits become negatively correlated with observed characteristics of the individuals because among individuals from relatively disadvantaged family backgrounds, only those with high ability or motivation continue schooling. Consequently, observed and unobserved characteristics are not statistically independent after the first transition.

In order to draw appropriate conclusions about the effect of family background characteristics and to correctly identify barriers to educational progression, it is clearly important to account for the existence of persistent heterogeneity in unobserved traits. A standard approach to account for unobserved heterogeneity is to allow for a finite mixture of types, say M types, each comprising a fixed proportion π_m ($m=1, \dots, M$) of the population (Heckman and Singer 1984, for an application see Eckstein and Wolpin 1999). In the finite-mixture's case, by definition, all heterogeneity could be accounted for if there are as many types as there are individuals. However, to the extent that groups of individuals are identical, or nearly so, the number of types necessary to account for heterogeneity would be less than the number of people. Hence the gain to this approach is considerable parsimony.

The models in this paper are estimated for two types. According to van den Berg (2001), it is standard practice to estimate models with a number of mass points that is either predetermined or equal to the maximum number that could be detected.

²² For details on the simplifying assumptions imposed on the educational model to define the origin and destination states see appendix 1.

Usually, if more than two or three points of support are taken then the estimates of some of them coincide. Since empirical identification of two points was already difficult in the analyses undertaken, additional points were not investigated.

The two types can be thought of as representing one group of highly motivated and/or gifted children and one group of less motivated and/or less gifted children. Setting $\eta_1 = 1$ and $\eta_2 = 0$, π_1 , the probability associated with η_1 is estimated (as is $\pi_2 = 1 - \pi_1$, the probability associated with η_2). To obtain a prespecified variance for η , η is multiplied by a constant ν . The constant ν is chosen so that $Var(\nu\eta) = 1$, a normalization needed to identify the factor structure and slope coefficients (Cameron and Heckman 2001).

The constant, ν , can be expressed in terms of π_1 as follows. First express $Var(\nu\eta)$ as a function of $\nu\eta_1$:

$$\begin{aligned} Var(\nu\eta) &= E[(\nu\eta)^2] - E[\nu\eta]^2 \\ &= [0 \cdot (1 - \pi_1) + (\nu\eta_1)^2 \cdot \pi_1] - [0 \cdot (1 - \pi_1) + (\nu\eta_1) \cdot \pi_1]^2 \\ &= \nu^2 \pi_1 - \nu^2 \pi_1^2 \end{aligned}$$

Then setting $Var(\nu\eta) = 1$:

$$\nu^2 (\pi_1 - \pi_1^2) = 1$$

Solving for ν , the positive root equals

$$\nu = \frac{\sqrt{\pi_1 - \pi_1^2}}{\pi_1 + \pi_1^2}$$

B. The log-likelihood function

Consequently, the log likelihood function for the model estimated in this paper is a finite mixture (or weighted average) of the type-specific log likelihoods, namely:

$$\begin{aligned} ll = \ln & \left\{ \pi_1 \exp \left(\sum_{j=1}^O \left(\sum_{k=1}^{D_j} d_{jk} \left(Z\beta_{jk} + \alpha_{jk} \nu\eta_1 - \ln \sum_{k=1}^D \exp \left(Z\beta_{j\bar{k}} + \alpha_{j\bar{k}} \nu\eta_1 \right) \right) \right) \right) \right\} + \\ & \left\{ \pi_2 \exp \left(\sum_{j=1}^O \left(\sum_{k=1}^{D_j} d_{jk} \left(Z\beta_{jk} + \alpha_{jk} \nu\eta_2 - \ln \sum_{k=1}^D \exp \left(Z\beta_{j\bar{k}} + \alpha_{j\bar{k}} \nu\eta_2 \right) \right) \right) \right) \right\} \end{aligned}$$

where Z is a vector of explanatory variables and $d_{jk} = 1$ if an individual chooses a particular transition and $d_{jk} = 0$ otherwise. Each transition probability is parameterized by a separate coefficient vector (both β_{jk} and α_{jk}) for each origin state j in the set O of origin states, and each destination k in the D_j choice set available to an individual with educational attainment j , as well as an unobserved heterogeneity component η governed by the distribution $F(\eta)$. Then β_{jk} and α_{jk} are the estimated parameters and the mass point, respectively. Finally, v is a constant as described above.

The predicted probability that a particular destination \tilde{k} is chosen by an individual with educational attainment \tilde{j} is computed based on the estimated coefficient vector by integrating out η using the distribution of $F(\eta)$ as follows:

$$\Pr(d_{\tilde{j}\tilde{k}} = 1 | Z, \eta) = \pi_1 \frac{\exp(Z' \beta_{\tilde{j}\tilde{k}} + \alpha_{\tilde{j}\tilde{k}} v \eta_1)}{\sum_{k \in D_{\tilde{j}}} \exp(Z' \beta_{\tilde{j}k} + \alpha_{\tilde{j}k} v \eta_1)} + \pi_2 \frac{\exp(Z' \beta_{\tilde{j}\tilde{k}} + \alpha_{\tilde{j}\tilde{k}} v \eta_2)}{\sum_{k \in D_{\tilde{j}}} \exp(Z' \beta_{\tilde{j}k} + \alpha_{\tilde{j}k} v \eta_2)}$$

where $D_{\tilde{j}}$ is the choice set available to the individual with educational attainment \tilde{j} . The probability of any educational career path may then be computed as the product of predicted probabilities.

As is common in multinomial logit models, it is necessary to normalize one benchmark state to zero for each choice set ($\beta_{\tilde{j}\tilde{k}} = 0$ and $\alpha_{\tilde{j}\tilde{k}} = 0$ for benchmark state \tilde{k} for each \tilde{j}). The benchmark chosen is the option in each choice set that most individuals choose. Finally, multinomial models are susceptible to collinearity within group, which most often occurs with discrete explanatory variables. The problem arises when all individuals choosing a given destination state have the same value of the dummy variable. If there is no variation in the explanatory variable, it is collinear with the intercept and the parameters cannot be estimated.²³

For example, in a number of transitions in the models estimated in this paper, both parents were present for all individuals, and consequently, the dummy variables for whether information was available about the father and the mother were zero for all. In fact, numerical estimation problems also arose when only a few individuals had missing information about the father and/or mother. To account for this problem,

²³ Therefore, a continuous variable for parental educational attainment was preferred in the analyses in this paper.

including the numerical one, the slope parameter, β_{jk} , for dummy variables was set to zero if less than five people differed from the majority value of the variable.

For rare events, i.e. transitions with less than 50 observations, only the intercepts and not the slope parameters in β_{jk} are estimated. Factor loadings for these parameters (α_{jk}) are also set to zero. This decouples rare transitions from the heterogeneity distribution while at the same time accounting for all of the observed sample paths. The number of observations (50) was chosen as two times the number of parameters to be estimated in the model. Cameron and Heckman (2001) handle rare events the same way.²³

V Empirical results

A. Descriptive analysis of educational progression

In this section, the main findings of a descriptive analysis of the pathways through the educational system chosen by native Danes, children of immigrants in the aggregate and by children of Turkish and Pakistani immigrants who left grade school from 1985 on are presented.

In table 2, probabilities for transitions from grade school to upper secondary educations or leaving school are shown. About 87 percent of native Danes start an upper secondary education within three years of completing grade school,²⁴ of these a little more than half choose the academic branch. The distribution is similar for children of immigrants in the aggregate (referred to in the tables as ethnic minorities), but covers large differences between individuals from different countries of origin as illustrated by the Turks and the Pakistanis. The share of Pakistanis who starts an upper secondary education is about the same as for native Danes, but the Pakistanis are more likely to choose the academic branch. In contrast, the Turks are much less likely to start an upper secondary education and unlike the Pakistanis and the native Danes, a larger share of those who do start chooses a vocational upper secondary education.

²³ The number of transitions subject to this restriction is two for the Turks, two for the Pakistanis, one for the children of immigrants, and zero for the native Danes.

²⁴ See appendix 1 for details on the computation of origin and destination states.

Table 2

Transitions from grade school to starting an upper secondary education or leaving the school system by ethnic group for children leaving grade school 1985-1999

	Upper secondary educations			Leave school	N
	All	Academic	Vocational		
	%	%	%	%	
Grade school					
ethnic minorities	84.6	46.8	37.8	15.4	8,065
Pakistanis	85.5	50.7	34.7	14.5	1,413
Turks	70.4	31.1	39.2	29.6	1,664
native Danes	86.8	45.5	41.3	13.2	79,632

Table 3 shows the dropout rates from the two branches of upper secondary education. It is evident that dropout rates are much higher among ethnic minorities than among native Danes. However, large differences in the dropout rates between the two branches of upper secondary education exist. About 60 percent of each of the three ethnic minority groups studied drop out of their vocational upper secondary education compared to 12-16 percent of the individuals who start an academic upper secondary education. It is interesting to note, that the dropout rate from vocational upper secondary educations is almost the same for all ethnic minority groups, whereas the dropout rate is higher for Turks and lower for Pakistanis from academic upper secondary educations. The dropout rates are much lower among native Danes, still as many as 32 percent drop out of vocational upper secondary educations.

Table 3

Number of individuals starting and the dropout rates from upper secondary educations by ethnic group and branch of education

	Academic		Vocational	
	Dropout rate (%)	Number of individuals starting the education ¹	Dropout rate (%)	Number of individuals starting the education ¹
ethnic minorities	13.4	2,387	58.0	1,688
Pakistanis	12.4	683	60.0	417
Turks	15.6	487	59.7	518
native Danes	8.8	36,966	32.1	35,560

¹ The number of individuals starting the education is not identical to the number of individuals starting the education according to the figures in table 2. The discrepancy is due to the exclusion of observations that are censored (see appendix 1 for details on the computation of origin and destination states).

For all ethnic groups, a larger share of women than men continues in upper secondary school upon completion of grade school although the differences are quite small (see table 4). However, substantial gender differences in the choice of branch of upper secondary education exist. The share of women choosing academic upper secondary school is much larger than the share of men, except among the Pakistanis where about 60 percent of those who start an upper secondary education of both sexes choose this branch. The gender difference in the share choosing an academic over a vocational upper secondary education is largest among native Danes.

Table 4 also shows that the dropout rate is lower among native Danes of both sexes, but the differences between native Danish men and ethnic minority men are much larger than the differences between the women. It is interesting to note that among ethnic minorities the dropout rate is lower for women than men whereas the opposite is true for native Danes.

High dropout rates from vocational upper secondary educations seem to be the key concern for all ethnic groups and both sexes. Still, native Danes perform better than ethnic minorities, and females perform better than males among the ethnic minorities. Substantial differences in educational choices are also identified between the Turks and the Pakistanis.

Table 4

The share starting and the share dropping out of upper secondary educations by ethnic group, sex, and branch of education

	Starting upper secondary educations			Dropout rates from upper secondary educations	
	All	Academic	Vocational	Academic	Vocational
	%	%	%	%	%
Men					
ethnic minorities	83.1	42.4	40.7	16.0	65.9
Pakistanis	84.7	51.6	33.2	13.6	66.8
Turks	67.8	26.6	41.2	16.3	72.5
native Danes	86.1	37.7	48.4	8.3	28.9
Women					
ethnic minorities	86.1	51.4	34.7	11.1	49.0
Pakistanis	86.4	49.8	36.7	11.0	52.7
Turks	73.0	35.8	37.2	15.1	46.5
native Danes	87.5	53.6	33.9	9.1	36.4

B. Model fit

Several specifications of the statistical model were estimated and compared.²⁶ Different sets of explanatory variables were included in different functional forms and different numbers of transitions were modeled. The final specification for each of the four ethnic groups studied was chosen based on convergence and model fit. The log-likelihood function value, the number of estimated parameters, the pseudo R^2 , and the probability associated with the factor loading of the final models are presented in table 5.²⁷

²⁶ The model is not available in any standard statistical package. For the purpose of this paper, the model was coded in GAUSS.

²⁷ The estimated parameter values and standard errors of the models are available from the author on request.

Table 5

Log-likelihood function values, total number of estimated parameters, pseudo R², and the probability associated with the factor loading by ethnic group

	Log-likelihood function value	Number of estimated parameters	Pseudo-R ²	π_1 *
Children of immigrants	-9,181.4	145	0.065	0.8361
Pakistanis	-1,742.9	86	0.074	0.9209
Turks	-2,181.2	95	0.054	-
Native Danes	-23,695.9	134	0.084	0.6170

* π_1 is the probability associated with the factor loading.

The number of parameters estimated for the Pakistanis is the lowest because the transition to a qualifying education for students who complete an academic upper secondary education is excluded from the model. Otherwise unobserved heterogeneity could not be identified empirically. For the Turks, the full model is estimated, but unobserved heterogeneity is not included because it could not be identified, even in a reduced model.

Small sample sizes are most likely a reason why unobserved heterogeneity is difficult to identify empirically for the two countries of origin. The value of π_1 for the Pakistanis shows that most of the individuals, 92 percent of the population, are categorized as type one, which also helps explain why identification of the unobserved heterogeneity is difficult. For children of immigrants and native Danes, the full model with unobserved heterogeneity is estimated. About 84 and 62 percent of the populations are categorized as type one, respectively. Finally, the pseudo R² varies between 0.054 and 0.084.

Table 6 shows that the models predict the transition probabilities of each of the ethnic groups well. In most cases, the actual sample outcomes and the predicted outcomes are identical in the first two significant digits. However, the predictions for transitions from vocational upper secondary educations for native Danes and children of immigrants are less accurate. Similarly the standard deviations are quite large for some of the transitions for children of immigrants and the Pakistanis. It turns out that the standard errors of the estimated parameters associated with the constant and the mass point are very high in these transitions. Hence the restrictive assumptions of the mixture distribution could be an explanation.

Table 6*Actual and predicted transition probabilities by ethnic group (standard deviation in parenthesis)*

	Native Danes			Children of immigrants			Pakistanis			Turks		
	Actual	Predicted	(SD)	Actual	Predicted	(SD)	Actual	Predicted	(SD)	Actual	Predicted	(SD)
From grade school to	Percentage											
Academic upper secondary	46.0	46.0	(0.41)	46.1	46.1	(11.73)	50.8	50.8	(41.23)	31.1	31.1	(1.11)
Vocational upper secondary	41.0	41.0	(0.45)	36.6	36.6	(9.83)	34.7	34.7	(23.03)	39.2	39.2	(1.16)
Leave school	13.0	13.0	(0.35)	17.2	17.2	(21.40)	14.5	14.5	(36.37)	29.6	29.6	(1.03)
From academic upper secondary to												
Graduation	89.2	88.5	(1.76)	82.1	81.9	(38.18)	84.0	82.2	(44.76)	79.5	79.5	(2.69)
Other	1.7	2.1	(1.46)	4.2	4.6	(2.40)	4.3	4.1	(2.43)	4.0	4.0	(1.37)
Dropout	9.1	9.3	(1.05)	13.8	13.5	(42.76)	11.8	13.6	(45.93)	16.4	16.4	(2.24)
From vocational upper secondary to												
Graduation	65.6	59.5	(3.65)	41.9	38.5	(3.03)	36.8	36.8	(36.98)	37.7	37.7	(3.06)
Other	1.0	2.6	(4.76)	2.3	2.1	(0.51)	4.6	4.6	(5.45)	1.4	1.4	(1.00)
Dropout	33.4	37.9	(3.47)	55.8	59.4	(3.17)	58.6	58.6	(41.88)	60.9	60.9	(2.99)
From completed academic upper secondary school to												
Qualifying education	67.5	65.9	(1.18)	76.0	75.6	(9.70)	-	-		68.6	68.6	(2.69)
Other	32.5	34.1	(1.18)	24.0	24.4	(9.70)	-	-		31.4	31.4	(2.69)

Note: Standard deviations (in parenthesis) are calculated using 500 random draws from the distribution of the underlying estimated parameters (see appendix 2 for details). The predicted probabilities are computed as the average over predicted probabilities for each individual.

C. Marginal effects of individual explanatory variables on educational choices after leaving grade school

Marginal effects of family background characteristics and characteristics of the neighborhood and the index child on the decision to start an upper secondary education are presented in table 7.²⁸ For native Danes, most of the explanatory variables are significant and have the expected effect on the decision to start an upper secondary education or not and on the choice of branch of upper secondary education. For example, an increase in parental educational attainment reduces the probability of leaving school after grade school and increases the probability of choosing an academic upper secondary education. Furthermore, the effects of parental educational attainment are quite large and the effect of maternal education on the choice of branch is larger than that of paternal education.

Growing up in a disadvantaged neighborhood significantly increases the probability of leaving school after grade school, but does not significantly affect the choice of branch while the share of ethnic minorities in the index child's grade school the year the child attended 9th grade significantly increases the probability of leaving school and significantly reduces the probability of starting an academic upper secondary education. Girls are significantly less likely to leave school and are more likely to choose an academic upper secondary education than boys.

²⁸ For continuous variables, the marginal effects show the percentage point change in the probability of choosing a specific destination for a small increase in the explanatory variable, i.e. dy/dx . For dummy variables, the marginal effects show the percentage point change in the probability of choosing a specific destination for a discrete change of the dummy variable's value (zero-one).

Table 7

The predicted probability for educational choices after leaving grade school and marginal effects of individual explanatory variables by ethnic group

	Native Danes			Children of immigrants		
	Academic	Vocational	Leave school	Academic	Vocational	Leave school
	percentage					
Predicted transition probability	46.00	40.97	13.03	46.15	36.61	17.25
Characteristics of the mother	percentage points					
Education of mother	41.54**	-31.44**	-10.09**	2.98**	-2.65**	-0.33
Gross income of mother	-0.06	0.92	-0.86	5.24**	-0.30	-4.94**
Work experience of mother	6.98**	-4.93**	-2.05**	-0.03	0.43	-0.40
Duration of stay in Denmark of mother	-	-		6.39**	0.77	-7.16**
Characteristics of the father						
Education of father	25.07**	-15.49**	-9.58**	5.01**	-2.72**	-2.29
Gross income of father	13.00**	-7.31**	-5.69**	-1.51	6.95*	-5.44
Work experience of father	-2.12**	2.85**	-0.73	3.50**	-0.02	-3.48**
Duration of stay in Denmark of father	-	-	-	2.84	-0.14	-2.70
Family structure						
Nuclear family	9.00**	-0.47	-8.54**	9.15**	-2.00	-7.15**
Number of children in household	-1.27	-1.92**	3.18**	-15.44**	6.53*	8.91**
Neighborhood						
Disadvantaged neighborhood	-4.83	-2.21	7.04**	-1.36	0.56	0.79
Share of ethnic minorities in 9th grade	-0.30**	-0.01	0.31**	-1.31*	1.83**	-0.51
Characteristics of child						
Female	16.18**	-13.94**	-2.25**	10.32**	-5.90**	-4.43**
Country of origin, Turkey	-	-	-	-18.50**	8.33**	10.17**
Country of origin, Pakistan	-	-	-	1.55	-0.14	-1.40

Table 7

continued

	Pakistani			Turks		
	Academic	Vocational	Leave school	Academic	Vocational	Leave school
	percentage					
Predicted transition probability	50.79	34.70	14.51	31.13	39.24	29.63
Characteristics of mother	percentage points					
Education of mother	4.55**	-3.23**	-1.32	0.34	-0.18	-0.16
Gross income of mother	-0.14	1.40	-1.26	0.51	5.09	-5.60
Work experience of mother	2.79*	-0.21	-2.58	3.73**	-0.98	-2.75*
Duration of stay in Denmark of mother	15.39**	-4.15	-11.25*	1.60	-1.30	-0.30
Characteristics of father						
Education of father	3.70**	-2.07	-1.63	4.94**	-1.99	-2.95**
Gross income of father	-22.12**	33.10**	-10.98	3.86	2.59	-6.45
Work experience of father	10.31**	-10.67**	0.36	7.21**	4.41	-11.62**
Duration of stay in Denmark of father	-5.34	7.11	-1.77	-3.49	-6.82	10.31*
Family structure						
Nuclear family	5.55*	2.85	-8.40**	6.80	-6.75	-0.05
Number of children in household	-22.21**	9.15**	13.07**	-6.64**	-2.14	8.78**
Neighborhood						
Disadvantaged neighborhood	1.02	1.59	-2.61	-0.97	-1.40	2.37
Share of ethnic minorities in 9th grade	-2.90**	1.78**	1.12	-1.43	1.92	-0.49
Characteristics of child						
Female	-0.56	2.99*	-2.44	9.35**	-3.68	-5.67**

Note: * and ** imply significance at the 10 and the 5 percent level, respectively. Standard deviations are calculated using 500 random draws from the distribution of the underlying estimated parameters.

However, the effects of maternal income and paternal work experience on the choice of branch are contrary to expectations. Both maternal income and paternal work experience negatively affect the decision to choose an academic upper secondary education and positively affect the decision to choose a vocational upper secondary education. Only the effects of paternal work experience are statistically significant. As discussed above, if high income is an indicator for long working hours and the mother's presence in the home is particularly important for her children's outcomes, then the negative effect of maternal income on the probability of choosing an academic upper secondary education may simply reflect the effect of long working hours. Similarly, if fathers with a vocational education have more work experience than fathers with an academic upper secondary education, but the same educational attainment measured in years, then work experience may control for whether or not the father has a vocational education. This would explain the observed results. Fathers with an academic upper secondary education as their highest completed education will most likely have lower work experience for two main reasons. One, it is more difficult to find employment for individuals without a qualifying education, and two, individuals with an academic upper secondary education may have spent some time pursuing an advanced tertiary education. The years spent studying would reduce their work experience proportionately.

Most of the explanatory variables also have the expected effects for ethnic minorities, but the significant effects vary between groups. For children of immigrants in the aggregate, parental educational attainment significantly affects the choice of branch, but not the decision to leave school. The effect of paternal education is larger than the effect of maternal education. The duration of stay of the parents also has the expected effects, but only the variable for the mother is significant. In contrast to the native Danes, living in a disadvantaged neighborhood does not significantly affect educational choices whereas the share of ethnic minorities in the index child's 9th grade school does affect the choice of branch. The indicator variable "country of origin, Turkey" shows that the Turks are significantly less likely to continue in upper secondary school and to choose the academic branch than other children of immigrants.

Living in a disadvantaged neighborhood does not significantly affect Pakistani and Turkish children either, but interestingly the direction of the effects is opposite for the two groups with the Pakistanis benefiting from living in disadvantaged neighborhoods. However, the variable for the share of ethnic minorities in 9th grade has the expected effects on the Pakistanis and the effects are significant for the choice of branch. In contrast to all other ethnic groups, Pakistani girls are significantly more likely than boys to start a vocational upper secondary education. The number of siblings has the expected effect on all groups by increasing the likelihood that the index child leaves school, but the effect on choice of branch is ambiguous.

A few variables have unexpected effects on the Pakistanis and the Turks, two of which are statistically significant. Paternal gross income decreases the probability that Pakistani children choose an academic upper secondary education and increases the probability that they choose a vocational upper secondary education. For the Turks, the duration of stay in Denmark by the father increases the probability that the index child leaves school although the effect is only significant at the 10 percent level.

D. Marginal effects of individual explanatory variables on dropping out

The marginal effects of family background characteristics and characteristics of the neighborhood and the index child on the decision to drop out of an academic and a vocational upper secondary education are presented in tables 8 and 9, respectively. Only two variables significantly affect the decision to drop out of an academic upper secondary education for all four ethnic groups; age at the start of the study and changing branch of study (see table 8). For all ethnic groups, the dropout rate is higher the older the student is when he starts his education and if he changes branch from an academic to a vocational upper secondary education. These are also the only significant variables for the Turks. Only two additional variables are significant for the native Danes for whom paternal income and living in a nuclear family significantly reduces the probability of dropping out.

In contrast, a larger number of variables affect the dropout rate of children of immigrants, including income and work experience of both parents as well as duration of stay in Denmark of the father and educational attainment of the mother. Women are significantly less likely and the Turks are significantly more likely to drop out of academic upper secondary educations. Furthermore, increasing the share of ethnic minorities in 9th grade and the number of siblings in the household also significantly increases the dropout rate of children of immigrants.

Table 8

Predicted probabilities of dropping out of academic upper secondary educations and marginal effects of individual explanatory variables by ethnic group

	Native Danes	Children of immigrants	Pakistanis	Turks
	percentage			
Predicted transition probability	9.35	13.43	13.70	16.45
	percentage points			
Characteristics of mother				
Education	-3.28	-1.50*	-2.60**	0.40
Gross income	-0.50	-3.41**	0.23	-6.82
Work experience	-1.02	1.82**	-1.21	-1.49
Duration of stay in Denmark	-	-0.13	7.92**	-5.75
Characteristics of father				
Education	-0.24	0.28	1.35	1.30
Gross income	-6.00**	-6.47**	3.70*	-9.23
Work experience	-0.52	-2.05*	-0.80	2.84
Duration of stay in Denmark	-	-5.68**	-24.83**	7.95
Family structure				
Nuclear family	-6.16**	-1.19	-2.80	-7.61
Number of children in household	-0.19	2.71**	-5.82*	-2.20
Neighborhood				
Disadvantaged neighborhood	5.60	-1.70	0.72	0.00
Share of ethnic minorities in 9th grade	0.20	1.71**	1.84**	2.35
Characteristics of child				
Female	0.73	-5.01**	1.63	1.81
Age when starting education	43.89**	72.65**	143.31**	100.41*
Country of origin, Turkey	-	6.12**	-	-
Country of origin, Pakistan	-	0.92	-	-
Change of study	9.55**	21.65**	39.05**	36.56**

Note: * and ** imply significance at the 10 and the 5 percent level, respectively. Standard deviations are calculated using 500 random draws from the distribution of the underlying estimated parameters.

The direction of the effects of some of the parental background variables for the Pakistanis is unexpected. For example, increasing income and duration of stay of the mother increases the dropout rate as do educational attainment and income of the father. Only the effect of the duration of stay of the mother, however, is significant at the five percent level. Interestingly and in contrast to all the other ethnic groups studied, increasing the number of siblings reduces the dropout rate for the Pakistanis whereas the share of ethnic minorities in 9th grade has the expected positive effect.

The marginal effects for the decision to drop out of a vocational upper secondary education are presented in table 9. Ethnic minority women are significantly less likely to drop out of a vocational upper secondary education than men whereas the opposite is true for native Danes. The reason is most likely that ethnic minority women choose a few selected fields of vocational study with lower dropout rates whereas the concentration of native Danish women in particular fields is less pronounced (Colding 2004).

Maternal educational attainment reduces dropout as expected, but the effect is only significant for the Turks and the Pakistanis. Contrary to expectations paternal educational attainment increases the dropout rate for all three ethnic minority groups and the effect is significant for children of immigrants and the Pakistanis. Paternal education is significant and has the expected effect for native Danes. Paternal work experience reduces dropout significantly for children of immigrants and the Turks while maternal work experience significantly reduces the dropout rate of native Danes. The share of ethnic minorities in 9th grade significantly affects the dropout rate of children of immigrants in the aggregate while the number of siblings in the household increases the dropout rate for all groups except the Turks.

For all four ethnic groups, students who change to an academic upper secondary education have a significantly lower risk of dropping out. The reasons may be that primarily individuals who are better educationally prepared from grade school make this transition and that graduation from academic upper secondary educations does not depend on finding an apprenticeship. It is also interesting to note that for vocational studies the dropout rate is lower the older the native Danish student is when she/he starts the education. Vocational upper secondary educations qualify individuals for specific job categories. Older students have most likely worked some years as unskilled laborer, are more mature, and are also more likely to have family obligations; all of which imply that these students are more motivated to complete their education than their younger colleagues.

Table 9

Predicted probabilities of dropping out of vocational upper secondary educations and marginal effects of individual explanatory variables by ethnic group

	Native Danes	Children of immigrants	Pakistanis	Turks
	percentage			
Predicted transition probability	37.86	59.39	58.66	60.95
Characteristics of mother	percentage points			
Education	-2.08	-1.34	-6.06**	-4.22**
Gross income	1.40	-4.03	-4.79	-8.09
Work experience	-2.43	0.18	-1.17	1.19
Duration of stay in Denmark	-	-14.04	0.13	-10.65
Characteristics of father				
Education	-7.46**	4.81*	7.89**	4.08
Gross income	0.11	9.05	36.04	34.48**
Work experience	-0.25	-7.97**	-6.25	-23.28**
Duration of stay in Denmark	-	-0.31	-17.53	14.04
Family structure				
Nuclear family	-11.56**	2.70	2.51	12.43
Number of children in household	2.78*	7.64*	13.50*	-12.53
Neighborhood				
Disadvantaged neighborhood	3.33	0.72	10.49*	8.80
Share of ethnic minorities in 9th grade	0.17	3.30**	1.78	2.31
Characteristics of child				
Female	11.23**	-9.57**	-13.23**	-10.96*
Age when starting education	-42.16**	-32.57	37.80	-73.56
Country of origin, Turkey	-	2.78	-	-
Country of origin, Pakistan	-	2.02	-	-
Change of study	-23.23**	-22.64**	-27.47**	-19.94*
School apprenticeship	8.01	-37.71**	-	-

Note: * and ** imply significance at the 10 and the 5 percent level, respectively. Standard deviations are calculated using 500 random draws from the distribution of the underlying estimated parameters.

E. Counterfactual simulations: changing all covariates

The observed differences in schooling choices and educational attainment between ethnic minorities and native Danes can be divided into differences in preferences for education and differences in endowments such as parental characteristics (Cameron and Heckman 2001). Preferences are expressed in the estimated parameters of the models and endowments in the values of the covariates. In table 10, the predicted transition probabilities are computed for all ethnic groups under study using average values of the covariates equal to those of an average native Dane. In addition, for each of the three ethnic minority groups the difference between predicted probabilities with covariates equal to those of an average native Danish child and predicted probabilities with their own covariates is also computed and it is indicated whether the difference is statistically significant. If the gap between the transition probabilities of native Danes and ethnic minority groups disappears when ethnic minority groups are given Danish background characteristics the observed differences in schooling choices can be assigned to differences in endowments and not behavior. If, however, differences in schooling choices persist, behavioral differences exist between the ethnic groups.

Table 10

Predicted probabilities computed with background characteristics equal to an average native Dane as well as the percentage point difference in predicted probabilities for ethnic minorities with their own average characteristics and average native Danish characteristics by ethnic group

	Native Danes	Children of immigrants		Pakistanis		Turks	
	Predicted probability	Predicted probability ¹	Difference ²	Predicted probability ¹	Difference ²	Predicted probability ¹	Difference ²
From grade school to							
Academic upper secondary	44.66	57.64	11.30 **	70.43	17.96 **	45.68	15.02 **
Vocational upper secondary	44.99	32.09	-5.74 **	25.94	-9.47 **	39.84	-0.96
Leave school	10.36	10.27	-5.57 **	3.63	-8.49	14.48	-14.07 **
From academic upper secondary to							
Graduation	90.69	86.10	1.17	84.68	0.08	84.09	2.27
Other	1.44	5.30	1.96	4.33	0.00	4.26	0.12
Dropout	7.87	8.60	-3.13 **	11.00	-0.09	11.65	-2.39
From vocational upper secondary to							
Graduation	60.22	45.51	7.83	44.19	8.46	50.29	14.87 *
Other	2.17	2.53	0.43 *	5.54	1.06	1.87	0.55
Dropout	37.61	51.97	-8.27 **	50.27	-9.52	47.84	-15.42 *
From completed academic upper secondary school to							
Qualifying education	67.48	76.49	-2.88	-	-	66.95	-3.82
Other	32.52	23.51	2.88	-	-	33.05	3.82

Note: * and ** imply significance at the 10 and the 5 percent level, respectively. Standard deviations are calculated using 500 random draws from the distribution of the underlying estimated parameters.

¹ Average native Danish values of the following variables are used to compute the predicted probabilities for the ethnic minority groups: parental education, parental income, parental work experience, disadvantaged neighborhood, share of ethnic minorities in 9th grade, nuclear family and number of children in household. Average values of the variables for duration of stay of parents in Denmark remain at the average values of the ethnic minority groups themselves as do indicator variables for missing educational information of each parent and whether or not information about parents is available. The values of the average native Danish characteristics are corrected to account for the values of the indicator variables of the ethnic minority group. This is particularly important for the variables for educational attainment of parents because the share of missing values is much larger for ethnic minorities than for native Danes.

² The difference is computed as the predicted probability computed with average native Danish characteristics less the predicted probability computed with the ethnic minority group's own average characteristics. In both cases, the estimated parameters for the ethnic minority group are used.

Giving children of immigrants background characteristics equal to those of an average native Danish child significantly reduces dropout rates from upper secondary educations as well as the share of children of immigrants who do not start an upper secondary education upon completion of grade school. The share of children of immigrants who choose an academic upper secondary education increases by about 11 percentage points to over 57 percent. In fact, the difference in the choice of branch of upper secondary educations between children of immigrants and native Danes increases. For the Pakistanis, the difference in the choice of branch becomes even greater. In contrast, it is evident from the table that the Turks become much like native Danes at this early stage in the educational system. However, for all three ethnic minority groups, the dropout rate from vocational upper secondary educations is reduced when they are given background characteristics like an average native Danish child, but the difference between them and native Danes remains large. Hence the differences between ethnic minorities and native Danes remain large even when all ethnic groups are given the same background characteristics. The differences in the transitions from grade school are most likely caused by differences in behavior. In many countries, vocational occupations are considered low status. In a country like Denmark where tuition is free, parents from such countries will encourage their children to choose an academic upper secondary education. The results of the simulations confirm that children of immigrants and the Pakistani children are much more inclined to choose the academic branch.

The differences in the transitions from vocational upper secondary educations also suggest behavioral differences between ethnic minorities and native Danes. However, discrimination by employers with regard to apprenticeships, inadequate Danish language proficiency and educational preparedness, and inadequate educational performance due to incompatibility with teaching methods that require a high level of individual maturity and initiative as well as group work may be also be important reasons why ethnic minorities drop out. For example, the academic preparedness of almost 50 percent of ethnic minority children does not meet the requirements for successful completion of an upper secondary education in Denmark according to Egelund (2003). In comparison, the figure is 18 percent for native Danish children. Unfortunately, data are unavailable for these individual, institutional, social and cultural factors which are therefore not controlled for in the analyses.

In table 11, simulations of the share of children from each of the ethnic groups under study reaching selected educational attainment levels are presented. Educational attainment is computed as the product of predicted probabilities as discussed in section IV B. For the ethnic minority children, educational attainment is computed using both their own background characteristics and characteristics equal to an average native Dane.

The table shows that a larger share of the children of immigrants and Pakistani children than native Danes would graduate from an academic upper secondary education if they had background characteristics like an average native Dane, otherwise about the same share would graduate. The increase is primarily due to a sharp increase in the share of children starting an academic upper secondary education although the dropout rate also decreases. It is interesting to note that the Turks become very similar to native Danes in terms of the share of children starting and completing an academic upper secondary education when covariates are equal to an average native Dane.

Table 11

Predicted educational attainment with own covariates and covariates equal to an average native Dane by ethnic group

	Native Danes	Children of immigrants	Pakistanis	Turks
	Own covariates	Danish family covariates ¹	Own covariates	Danish family covariates ¹
Academic upper secondary education				percent
Start	44.66	57.64	46.34	70.43
Dropout	3.51	4.96	5.43	7.74
Graduate	40.50	49.63	39.36	59.64
Qualifying education				
Start	27.33	37.96	31.24	-
Vocational upper secondary education				
Start	44.99	32.09	37.82	25.94
Dropout	16.92	16.67	22.78	13.04
Graduate	27.09	14.60	14.25	11.46

Note: Educational attainment is computed as the product of predicted probabilities as discussed in section IV B.

¹ Average native Danish values of the following variables are used to compute the predicted probabilities for the ethnic minority groups: parental education, parental income, parental work experience, disadvantaged neighborhood, share of ethnic minorities in 9th grade, nuclear family and number of children in household. Average values of the variables for duration of stay of parents in Denmark remain at the average values of the ethnic minority groups themselves as do indicator variables for missing educational information of each parent and whether or not information about parents is available. The values of the average native Danish characteristics are corrected to account for the values of the indicator variables of the ethnic minority group. This is particularly important for the variables for educational attainment of parents because the share of missing values is much larger for ethnic minorities than for native Danes. Both the predicted probability computed with average native Danish characteristics and the predicted probability computed with the ethnic minority group's own average characteristics are computed using the estimated parameters for the ethnic minority group.

Changing from own covariates to average native Danish covariates does not affect the share of children of immigrants and Pakistani children completing a vocational upper secondary education much. The share is about half that of native Danish children. However, the table also shows that the share of children from both ethnic groups starting a vocational upper secondary education decreases, particularly among the Pakistani children. Consequently, the dropout rate is also reduced.

The effect of changing covariates is different for the Turks who become more similar to the native Danes. The share starting a vocational education does not change much, but the dropout rate is substantially reduced and consequently, the share of Turkish children completing a vocational upper secondary education increases by 5-6 percentage points to 20 percent. The dropout rate thus remains much higher than the dropout rate among native Danes.

Finally, the table also shows that regardless of background characteristics, a larger share of children of immigrants starts a qualifying education and that changing covariates the Turks become similar to native Danes also with regard to this transition. Behavior thus seems to be quite different between native Danish children and children of immigrants in the aggregate and in particular between native Danish children and Pakistani children, but more similar between native Danish and Turkish children. The findings suggest that for children of immigrants in the aggregate and for Pakistani children, the main reason for the observed differences in educational attainment is the high dropout rate from vocational educations whereas an additional problem for the Turks is the weak family background of the children.

VI. Conclusion

Previous studies conclude that the educational attainment of ethnic minorities in Denmark is much lower than the educational attainment of native Danes and that large differences in the educational distributions are likely to persist because intergenerational mobility is low and of equal magnitude for the two groups. In this paper, educational attainment is modeled as the outcome of sequential multinomial decisions from the child leaves grade school until she graduates from a vocational upper secondary education or starts a qualifying education upon completion of an academic upper secondary education. This approach improves on previous work in four important ways. First, the model controls for educational selection bias and unobserved heterogeneity. Second, the model is able to correctly account for the institutional structure of the Danish educational system, which contains parallel branches of study at both the upper secondary and tertiary level. Third, by modeling sequential educational choices, it is possible to identify critical decision points in the educational system at which ethnic minority behavior differs from that of native Danes. Finally, it is possible to determine how background characteristics affect

behavior at different decision points. In short, the model is better able to explain differences in educational attainment between population groups.

The statistical model used is a parsimonious version of Cameron and Heckman's (2001) model of educational progression. In the paper, analyses are undertaken separately for four ethnic groups: native Danes; children of immigrants in the aggregate; the Turks; and the Pakistanis. In spite of the parsimonious specification of the model, unobserved heterogeneity is only identified empirically for native Danes and children of immigrants in the aggregate. Breen and Jonsson (2000), who use a similar model on a large Swedish data set, report no difficulties with identification. However, they do conclude that even rather simple multidimensional models such as the one they use may demand fairly large data sets to be useful in empirical research. Relatively small sample sizes with large sample attrition due to a skewed age distribution of the population under study and educational selection are probably the reasons that unobserved heterogeneity is only identified empirically for the Pakistanis in a model that does not include transitions at the tertiary level while it is not possible to identify unobserved heterogeneity for the Turks at all. The educational attainment of the Turks is thus analyzed using a sequence of independent cross sectional transition probabilities.

Descriptive results point to two important barriers to educational progression of children of immigrants. First, high dropout rates, particularly from vocational upper secondary educations, seem to be the main reasons minority children in Denmark have much lower educational attainment than native Danes. As many as 60 percent of the ethnic minority children starting a vocational upper secondary education drop out compared to about 32 percent of the native Danes whereas the dropout rates from academic upper secondary educations are about 14 and 9 percent for minority children and native Danes, respectively. Second, children of Turkish origin have a very low entry rate into upper secondary educations.

Focus in the econometric analyses is therefore directed towards explaining these two features of the data. Most of the explanatory variables have the expected effects on educational choices, but the magnitude and significance level vary by transition and ethnic group. Simulations show that the low entry rate of the Turks into upper secondary educations is primarily due to intergenerational transmission of their parents' weak socio-economic status. That is, if these children were endowed with family characteristics equal to those of an average native Dane, their transition rates into upper secondary educations would be much like that of native Danish children. The gap between native Danish children and minority children in dropout rates from vocational upper secondary educations, on the other hand, remains large even when the endowments of minority children are changed, although the dropout rates are

substantially reduced. It would thus appear that the high dropout rates are mainly due to behavioral differences and/or factors not controlled for in the analyses, including discrimination.

The analyses use administrative data from registers in Statistics Denmark. Register data are not susceptible to the errors in reporting common in surveys. However, on the downside, information is not available from clarifying behavioral questions. Dropout decisions from vocational upper secondary educations are likely to be affected by a number of factors for which information is not available in the registers. For example, inadequate educational preparedness and Danish language proficiency are according to qualitative studies of educational behavior of ethnic minorities in Denmark two important reasons why ethnic minorities drop out of upper secondary educations. In addition, vocational upper secondary educations consist of time spent at technical schools and time spent as an apprentice at a company. The demand for apprenticeships is greater than the supply overall. Consequently, social networks are extremely important for finding an apprenticeship, which puts ethnic minorities at a disadvantage. For ethnic minorities the problem of finding an apprenticeship is further exacerbated by discrimination from companies who prefer to take in native Danes. Furthermore, previous analyses show that ethnic minority children concentrate in a few fields of vocational educations and thus compete with each other for the limited number of apprenticeships open to ethnic minorities.

Interestingly, in contrast to native Danes, the dropout rate for women is lower than the dropout rate for men among the ethnic minorities. The reason is most likely that ethnic minority women concentrate in fields, such as the health field, with generally lower dropout rates. Another explanation may be the different behavioral rules pertaining to girls and boys, particularly teenagers, in ethnic minority families. Boys are allowed to leave the house to spend time with friends, to work and to pursue hobbies while women are not allowed to leave the house without a guardian. However, going to school or to study with girlfriends are legitimate reasons for leaving the house and thus women may be more inclined to stay in the educational system to be able to spend more time with friends.

In conclusion, it is imperative to formulate policies and interventions to ameliorate the effects of a disadvantaged family background on the educational choices of Turkish children in the short- and medium run, and that future research determines why the dropout rates are so much higher among minority children, particularly at vocational schools. Improving educational preparedness from grade school is undoubtedly a necessary prerequisite for removing both barriers to educational progression. Possible interventions include strengthening grade school teachers' qualifications in working with minority students and training guidance counsellors to advice minority students and their parents on issues pertaining to the educational system and career planning as early as grade school. In addition, tutors could assist

with homework and provide guidance with regard to study techniques as well as social aspects of student life, and finally, so-called homework cafes where students meet to work and spend time together could be an effective policy intervention to improve educational preparedness of both minority and native Danish children.

Appendix 1

Simplifying assumptions

A number of simplifying assumptions are imposed on the educational model to define the origin and destination states. First, upon completion of grade school, the individual will start an upper secondary education or leave the school system. An individual will be categorized as having left the school system if she/he has not started an upper secondary education within three years after completing grade school. Most people who start an upper secondary education do so within this timeframe. Another reason for imposing a timeframe is the skewed age distribution of children of immigrants. To be able to analyze subsequent educational decisions, it is necessary to focus the attention on individuals who start an upper secondary education shortly after completion of grade school.

Second, individuals are categorized as dropouts if they one year are enrolled in an education and the following two consecutive years have left the educational system without having completed the education they were enrolled in to start with. Consequently, changing branch of study is not included in the definition of dropouts because as long as the individual completes an education, it is considered less of a concern whether she changes branch of study along the way or takes a sabbatical year. Many students change their field of study in the first year or two after enrollment in a qualifying education. If a dropout subsequently starts an upper secondary education and is present in the data long enough to determine whether she/he completes the education, the individual will contribute two “spells” to the analyses of completion and dropping out of upper secondary school. Only very few such cases are included in the analyses.

Third, to accommodate sabbaticals and students changing studies, individuals are categorized as having completed their upper secondary education if they graduate within the prescribed duration of their education plus two years. For example, most academic upper secondary educations have a prescribed duration of three years, consequently an individual who starts an academic upper secondary education is categorized as having completed the education if she/he graduates within five years. If the individual does not complete the upper secondary education within the prescribed duration of the study plus two years and does not drop out she/he is categorized as belonging to the so-called residual group.

Fourth, individuals who complete an upper secondary education can choose between starting a qualifying education, i.e. a vocational upper secondary education or an advanced education, and leaving the educational system. An individual is categorized as having left the educational system if she/he does not start a qualifying education within two years. This restriction is imposed because of the age structure of ethnic minorities, but may be inexpedient for the analysis of native Danes, many of whom spend more than two years working and traveling before starting a qualifying education. The share of native Danes who start a qualifying education is therefore likely to be substantially underestimated. Finally, individuals are categorized as having completed their qualifying education if they graduate within the prescribed duration of the study plus two years. The definitions of dropout and the residual group are as described above.

In all transitions analyzed, individuals who are not present for the duration of the timeframe within which the destination states are defined are categorized as censored. For example, if an individual is not present in the data for two consecutive years following completion of grade school, she/he is categorized as censored. In the descriptive analysis, such individuals are included in the analysis if they are observed to make a transition. In the statistical analysis, individuals are only included in the analysis of transitions for which they are not censored.

Appendix 2

Computing standard deviations

Standard deviations of the predicted probabilities and the marginal effects were calculated using 500 random draws from the distributions of the underlying estimated parameters. A draw, z , was made from the K -variate standard normal distribution by stacking K independent draws from the univariate standard normal distribution (K being the number of estimated parameters in the model). Let T be the square root of Σ , the covariance matrix of the parameters, such that $TT' = \Sigma$. The desired parameter vector corresponding to the draw z is then just $\tilde{\beta} = \hat{\beta} + Tz$, where T is a lower triangular matrix obtained using a Cholesky decomposition on the covariance matrix (Greene 1997) and $\hat{\beta}$ is the estimated vector of parameters, including α . The predicted probabilities and the marginal effects were computed for each of the 500 parameter vectors drawn and the standard deviations of these predicted probabilities and marginal effects were computed.

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