Calculation of student value added in Danish Upper Secondary Education

Jesper Wittrup, KORA, September 2015

The analysis identifies schools' relative capacity, that is, their ability to get students to perform better than one might expect based on their professional and socio-economic base. To this end, multi-level models (Steele, 2008) are used to identify the effect on the grade of grade attributable to the school - and not the student's background characteristics or random student variation.

The analysis includes two different socio-economic indices, which we will here refer to as the simple and the expanded socio-economic index. The "simple" socio-economic index is formed by a Principal Components analysis of the following variables:

Variables included in the "simple" socioeconomic index

Variable	Description	Type	Coding	Handling of missing	TIMES reference (Stats Denmark)
Mother'sincome	Indication of mother's income in the last 5 years until the child reaches 15 years.	Integers (1-10)	The tax personal income for each year is converted to 2012 level. The average income over the 5 years is then placed in deciles .	If individual years are missing, these years are not included in the calculation of the mean. If all years are missing, the income is estimated based on training and job status variables. If these variables are also missing, the income is equivalent to a person without education beyond the primary school.	Based on PERINDKP
Father's income			As above		
Mother's education length	Estimated length of education based on information on highest education completed in the year the child reaches 15.	Intergers	0=highest primary school 2=vocational education 3=high school 5=Short higher education 6=Medium higher education 8=Long higher education	Set to 0	Based on HFFSP

11=PhD

Variable	Description	Type	Coding	Handling of missing	TIMES reference (Stats Denmark)
Father's education length	As above				
Mother's job prestige	Mother's ISEI-score in the year the child turns age 15.	Numerical	DISCO-code for main occupation coupled with ISEI-score (International Socio-Economic Index of Occupational Status)	Estimated based on income and education. If these variables are also missing, jobseekers are assumed to be equivalent to a person without education beyond primary school.	Based on DISCOK
Father's job prestige	As above				
Child age at exam	The age of the child in the year of the 9th grade of the final test.	Numerical	Age in 1 June in the year of graduation.	Set to average value	
Mother's relative age at time of birth	Mother's age at the time the child was born minus the average age	Numerical	Mother's age minus the average age of mothers in the population	Set to average value (ie 0)	
Father's relative age at time of birth	As above				

The principal component, which has also been shown in a previous analysis (Wittrup, 2011) to have a major explanation in relation to elementary school grades, is used as a socioeconomic index

While the "simple" socioeconomic index reflects the parents' income, education and status, it does not capture binary social background variables. In order to include these in an expanded socioeconomic index, the earlier detection of strong correlation between socio-economic variables and professional performance is utilized. The expanded socioeconomic index is based on a polynomial regression with the average grade of passing grade as dependent variable. As dependent variables, the components of the Principal Components analysis are used, as well as a number of additional variables, cf. the table below.

Yderligere variable, der indgår i det udvidede socio-økonomiske indeks

Variable	Description	Type	Coding	Times reference (Stat Denmark)
Turkish origin	Based on mother's country of origin	Categorical (dummy)	1=Mother's country of origin, Turkey	IELAND
Yugoslavian (former Yugoslavia) origin			As above	
Afghan origin			As above	
Iraqi origin			As above	
Pakistani origin			As above	
Lebanese origin			As above	
Somali origin			As above	
Moroccan origin			As above	
Sri Lankan origin			As above	
Iranian origin			As above	
Filippine origin			As above	
Vietnamese origin			As above	
Thai origin			As above	
Other non-western origin	Mother's origin is not part of the above, but characterized as non-western	Categorical (dummy)	1=Non-western origin but not one of the above	IELAND and IELANDG3
Other Western origin	Mother's Origin western (Non-Danish)	Categorical (dummy)	1= Western origin	IELAND and IELANDG3
Father with non-western origin	Father's origin non-western	Categorical (dummy)	1=Non-western origin	IELAND and IELANDG3
Cohabiting parents	The parents are cohabiting in the year when the child reaches the age of 15.	Categorical (dummy)	1= The parents have the same residence address	BOPIKOM
Mother self-employed	The mother is self-employed in the year the child is 15	Categorical (dummy)	1=111<=SOCSTIL <=120	SOCSTIL

Father self-employed			As above	
Variable	Description	Type	Coding	Times reference (Stat Denmark)
Mother top manager	The mother is top manager in the year the child is 15	Categorical (dummy)	1=SOCSTIL=31	SOCSTIL
Father top manager			As above	
Mother unemployed	The mother is unemployed in the year the child is 15	Categorical (dummy)	1=SOCSTIL=210	SOCSTIL
Father unemployed			As above	
Mother receives sickness benefit	The mother is a sickness benefit recipient in the year the child is 15	Categorical (dummy)	1=SOCSTIL=210	SOCSTIL
Father receives sickness benefit			As above	
Mother on early retirement	The mother is a retirement pensioner in the year the child is 15	Categorical (dummy)	1=SOCSTIL=321	SOCSTIL
Father on early retirement			As above	
Mother is a cash benefit recipient	The mother is a cash benefit recipient in the year the child reaches 15	Categorical (dummy)	1=SOCSTIL=330	SOCSTIL
Father is a cash benefit recipient			As above	
Mother has other (not employee or retired) socio-economic status	The mother is not classified as one of the above, nor as a wage earner, a pensioner or a retiree	Categorical (dummy)	Sosctil= missing, 310 (seeking education) , 410 "other" eller 999 (not in AKM)	SOCSTIL
Father has other (not employee or retired) socio-economic status			As above	
The student is more than 16½ years at the time of the examination	The student is June 1st of the exam year more than 16½ years.	Categorical (dummy)		

The expanded socio-economic index is the standard predicted elementary grade. Moreover, the two socio-economic factors are highly correlated.

For each of the written A-grade exams, in a multi-level model, the upper secondary grade is calculated. The model has the following independent variables.

Independent variables for calculation of grade effect in A-subject

Variable	Description	Type	Coding	Handling of missing	TIMES reference (Stats Denmark)
Expanded socioeconomic index			As described above		
Comrades socio-economic status	Mean value of socio-economic index of students taking the A subject at the upper secondary school	Numerical			
Student's gender			1=boy	Set to 0	
Non-western origin	Mother's origin non-wester	Categorical (dummy)	1=non-western origin	IELAND and IELANDG3	Based on DISCOK
Variables for socioeconomic status (self-employed, senior executives, unemployed, etc.), Western origin, cohabiting parents, and student age as described above.					
Exam results in Danish law writing in the 9th grade of the final exam	Exam result	Integer (12-grade scale)	Converted to 12-grade scale if old scale	If "missing" is replaced by the predicted character (socioeconomic index)	KARAKTER
Exam results in written Danish at the 9th grade final exam			As above		
Examination results in oral Danish at the 9th grade final exam			As above		
Exam results in Danish order at the 9th grade final exam			As above		
Exam results in oral			As above		

English at the 9th grade final exam

Variabel	Beskrivelse	Type	Kodning	Håndtering af "missing"	TIMES henvisning
Exam results in a problematic problem statement in the 9th grade final exam	Exam result	Integer (12-grade scale)	Converted to 12-grade scale if old scale	If "missing" is replaced by the predicted character (socioeconomic index)	KARAKTER
Exam results in mathematical proficiency at the 9th grade final exam	Exam result	Integer (12-grade scale)	Converted to 12-grade scale if old scale	If "missing" is replaced by the predicted character (socioeconomic index)	KARAKTER
Exam results in physics/chemistry proficiency at the 9th grade final exam	Exam result	Integer (12-grade scale)	Converted to 12-grade scale if old scale	If "missing" is replaced by the predicted character (socioeconomic index)	KARAKTER
The student has not obtained any grades in elementary school	The student is not registered with grades in the bound school examinations	Categorical (dummy)	1=no lower secondary school grades		
HTX	The student takes the subject at a technical high school	Categorical (dummy)	1=HTX		
HHX	The student takes the subject at a business high school	Categorical (dummy)	1=HHX		
The student has German origin	Based on mother's country of origin	Categorical (dummy)	1= Mother's country of origin Germany	IELAND	

It should be noted:

• The calculation of student value added in A-subjects is based on a sampling of variables for socio-economic reasons, as the socio-economic index replaces a number of variables. This has been done on the basis that the majority of social background variables individually appear to have a non-significant effect on the A-subject grades when checking for elementary school grades (but the accumulating expanded index has a significant effect).

• Some variables are included both in the establishment of the expanded socioeconomic index AND in the model for calculating student value added in A-subjects. This makes it difficult to interpret the effects of these variables. It is therefore important to emphasize that the part of the analysis discussing effects of variables is based on an alternative model where no such overlap occurs (the "simple" socioeconomic index is used).

Student value added is calculated for the following subjects at A level:

- Marketing
- Biology
- Biotechnology
- Danish
- Danish IT
- English
- English IT
- Operations
- French
- French beginning language
- French continuation language
- Physics
- International economy
- Italian
- Chemistry
- Latin
- Mathematics
- Music
- Socialstudies
- Spanish
- German
- German continuation language
- Business economy

Other A subjects characterized by having less than 1000 students for a written exam during the period are collected under "other", which is analyzed as one group.

The overall capacity of the high school is calculated by weighting the value added skills in the individual subjects on the basis of the number of pupils, the upper secondary school, having passed the exam in each of the subjects concerned.