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PEER EFFECTS AND SCHOOL DESIGN: EVIDENCE FROM SWISS LOWER SECONDARY SCHOOLS

Abstract

The current paper estimates peer effects in lower secondary schools using a Swiss national survey based on international PISA 2006 questionnaires. The magnitude and nature of social interactions between classmates is a prominent argument when schooling policies such as school desegregation are discussed. In Switzerland, students are not only tracked between but also within lower secondary schools. Empirical results suggest only partial evidence for efficiency gains regarding grouping policy. On the one hand, my findings report that class heterogeneity in terms of economic, social and cultural status decreases the average performance in the classroom but not in a significant way. On the other hand, pupils in the lowest parts of the ability distribution benefit most from peer effects. Finally, by analyzing equality of opportunity, my results indicate that class heterogeneity can compensate for the impact of family background on student's performances, especially in mathematics.

Key words:

Education, Peer effects, PISA.

JEL: I2, I28, J24.

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1. Introduction

Educational achievement is theoretically associated with school quality attributes, individual inputs and parental background characteristics. However, there is no clear relationship between educational inputs and student outcome (Hanushek, 1986). In fact, school quality depends rather on the kind of pupils attending the establishment than the facilities the school offers. This argument explains why scholars have been interested by the role of peer effects in education. Peer effects theory considers that group behavior and characteristics have an influence on the individual outcome or choice. This approach does not span only the field of education but also fields such as health (Fletcher, 2009), sociology (Davies and Kandel, 1981), psychology (Jaccard, Blanton and Dodge, 2005) or sport (Ashworth and Heyndels, 2007). The importance of classmates' background or abilities on student outcome is not a new idea in the extent that we already find this intuition in the Coleman report (1966): «Attributes of other students account for far more variation in the achievement of a minority group children than do any attributes of school facilities and slightly more than do attributes of staff».

Furthermore, the magnitude and nature of social interactions between classmates is a prominent argument when schooling policies such as school segregation (versus school desegregation) are discussed. The debate between tracking and mixing students relies on two distinct criteria, efficiency and equity, that often conflict with each other. Proponents of a selective system consider that tracking students maximizes student outcome (measured through the accumulation of cognitive aptitudes) by forming more homogenous classes where the teacher can adapt his program to different kinds of students by focusing on their specific needs. This segregation is especially advantageous for smart students who are so not slowed down in their learning process by the presence of low-ability students. However, efficiency is not the only concern of schooling policy. Non-economic objectives like increasing educational opportunities and social cohesion have to be satisfied too. Tracking students reduces equality of opportunities by regrouping together students with the same skills. In this situation, students with learning difficulties do not benefit from the knowledge and the motivation of clever peers who are so defined sources of positive externalities. Slavin (1990) argue that pupils in lowest school tracks are demoralized and have less expectations about their future. But, at the same time, low-ability students benefit from more specialized courses and they are not eclipsed by brighter students.

Advocates of a comprehensive system insist on the fact that mixing students increases educational opportunities and intergenerational social mobility. The traditional way to account for equity in education is to consider the intergenerational mobility of human capital (Woessman, 2004; Bauer and Riphahn, 2004) or earnings (Pekkarinen and al., 2009). Some recent studies analyze if the family background effect is reinforced or weakened by the schooling policy (Brunello and Checchi, 2006; Schuetz and al., 2005, Raitano and Vona, 2010). In general, it is assumed that a comprehensive system is less efficient that the tracking one because the teacher has to find the right «mix» in students' needs. Nevertheless, mixing students can be considered as efficient if low-ability students benefit more from peer effects than high-ability pupils whereas an increase in class heterogeneity does not affect the overall schooling achievement. Peer effects theory is then an elegant way to analyze school efficiency through social interactions.

This paper uses peer effects theory to revisit the organizational design of the Swiss lower secondary level and to estimate the potential benefits that a comprehensive system could generate. Prior empirical studies for Switzerland focused rather on the postponement of the timing of first tracking than on a possible change in the structure of the schooling system. Bauer and Riphahn (2006) find that children with highly educated parents benefit more from early tracking in terms of educational achievement (measured through college-bound attendance). Falter (2010) extends the previous study by using a more precise educational outcome (which includes different school tracks) and by introducing a measure of ability in the regression model. His results suggest that, in early tracking cantons, students with advantaged socio-economic background have a low probability for ending in the lower school tracks. The present paper analyzes if there are potential advantages to go further that is, to reallocate students in a mixing way.

I make two contributions compared to previous literature. The first is empirical in the extent that until now, no paper estimated peer effects in the Swiss schooling system whatever the educational level (i. e. primary, lower and upper secondary or tertiary). The second contribution is methodological. Prior literature in peer effects considers either comprehensive systems (Rangvid, 2004) either tracking systems where students are sorted at the school level (Lefgren, 2004; Schneeweis and Winter-Ebmer, 2007) but not systems where students are explicitly tracked within schools. Unfortunately, PISA international survey only gives the possibility to analyze peer effects at the school level, which is not relevant for our purpose. It is why I take advantage of a Swiss national survey based on international PISA 2006 questionnaires to obtain information at canton, school, school track and class levels. To my basic knowledge, I am not aware of similar analyses.

Empirical results suggest only partial evidence for efficiency gains regarding grouping policy. On the one hand, my findings report that class heterogeneity in terms of economic, social and cultural status decreases the average performance in the classroom but not in a significant way. On the other hand, pupils in the lowest parts of the ability distribution benefit most from peer effects. Finally, by analyzing equality of opportunity, my results indicate that class heterogeneity can compensate for the impact of family background on student's performances, especially in mathematics.

The paper is structured as follows. The second part discusses the concept of social interactions, the econometric issues related to peer effects estimation and the related literature. The third part presents the structure and the selection procedure at lower secondary level in Switzerland and the models and data used for the empirical analysis. Results are presented in section four. Section five concludes.

2. Social interactions and related literature

Literature in economics of education using peer effects theory is growing since the publication of the Coleman report (1966) which insists on the importance of school- or classmates on educational outcome. According to the conceptual framework of Manski (1993), there are three arguments which explain why individuals belonging to the same reference group that is, the same class in the present case, tend to behave similarly. These arguments, their econometric issues and the corresponding literature are presented in the following paragraphs.

Firstly, *endogenous effects* exist when the outcome of your peers influence your own outcome. Considering educational achievement as outcome, these effects reflect the influence of peer group *ability* on student's performances. Note that endogenous effects are policy relevant in the extent that they create a social multiplier through the following mechanism: a schooling policy affecting the behavior of some individuals (i. e. treated individuals) affects the behavior of the entire group (i. e. even non-treated individuals) which in turn has a feedback effect on treated individuals.

The first challenge when we estimate peer effects is to reduce the simultaneity (or reflection) problem existing between individual and peer group outcomes. The main strategy adopted in the literature consists in using a lagged peer outcome as peer ability variable. Vigdor and Nechyba (2004) estimate the influence of classmates on student's performances in fifth grade in North Carolina Public Schools by considering the mean test performance in third grade as peer ability measure. In a similar way, Lefgren (2004) considers the mean prior grades as peer ability variable for estimating peer effects in Chicago public schools. For England, Gibbons and Telhaj (2008) analyze if student's performances at secondary level are associated with the proportion of students in secondary school who performed well at primary level. However, the problem of simultaneity is only reduced but not completely eliminated.

Secondly, c*ontextual effects* occur when the exogenous characteristics of the peer group, defined as the peer group *quality* attributes, influence the individual outcome. Here, however, policy interventions do not create spillover effects because these social interactions rely on attributes unaffected by the current behavior of the individuals. Such social influences have been investigated by taking different attributes to proxy for peer group quality e. g. educational level of the mother (Mc Ewan, 2003; Rangvid, 2004), highest parental occupational status (Schneeweis and Winter-Ebmer, 2007), economic, social and cultural status (Raitano and Vona, 2010), number of students from dissolved families (Bonnesronning, 2008) or the proportion of students with working parents (Fertig, 2003).

The second challenge in the estimation procedure is to separate out the influence of the peers' characteristics (peer *quality*) from that of the peers' outcome (peer *ability*). Indeed, the former determines the later and this situation creates a problem of multicollinearity. Solutions to this problem are related to the data available. In general, cross-sectional studies do not include measures of lagged achievement. This limitation explains why cross-sectional studies estimate only contextual effects (Mc Ewan, 2003; Rangvid, 2004; Schneeweis and Winter-Ebmer, 2007). On the contrary, studies working with longitudinal data focus rather on endogenous effects because they take advantage of their data to include prior student's performances in their models. Most of the time, these studies use demographic variables (e.g. gender or race) instead of parental background variables as peer group characteristics in order to reduce the reflection problem (Hoxby, 2000; Fertig, 2003; Gibbons and Telhaj, 2008).

Thirdly, *correlated effects* arise when individuals in the same reference group behave similarly because they face similar environments. Whereas endogenous and contextual effects are driven by social interactions, correlated effects are not a social phenomenon. The underlying problem is that peer group composition (and student outcome) is often influenced by unobserved factors and it is by definition non-random. Solving the selection bias is the most important challenge in peer effects estimation and this explains why recent literature focuses essentially on this issue. Different identification strategies have been considered in observational studies. Analyzing the case of Denmark where students are mixed during compulsory schooling, Rangvid (2004) uses a long form model including a lot of parental background attributes in order to reduce the omitted variables bias. An alternative approach to account for self-selection bias is to adopt an instrumental variable strategy. Using two-stage least squares, the idea is to describe explicitly the selection mechanism in a first stage regression. Fertig (2003) uses two sets of instruments: a first set including an indicator of school selection mechanisms and a variable indicating whether the school is public or private and a second set containing parental characteristics. The instrument used by Lefgren (2004) is the interaction term between student prior test scores and school's tracking policy. De Paola and Scoppa (2009) analyze peer effects in a middle-sized Italian public university. Their dependent variable is the average grade in exams obtained by the student during her first year of secondary level degree courses. In order to solve the endogeneity problem, they used as instrument for peer quality the average grade of students who attend the same courses and were in the same class during the first level degree courses. However, as relevant instrument are not often available, the most popular approach in the literature is to consider fixed effects methods. Many researchers have considered school fixed effects to control for school differences when tracking occurs at school level (Mc Ewan, 2003; Vigdor and Nechyba, 2004; Ammermueller and Pischke, 2007; Schneeweis and Winter-Ebmer, 2007, Gibbons and Telhaj, 2008). Whereas school fixed effects control only for time-invariant unobserved attributes, we can suppose that time-varying factors are also correlated with peer group formation. This is especially the case in the study of Lavy and al. (2009) who estimate peer effects in the classroom by making a distinction between repeaters and regular students. The authors then control for the variation of repeaters across different cohorts within the same schools by using school linear time trends. Of course, the best approach is to adopt an experimental policy design. Sacerdote (2001) considers peer effects on schooling performances among college roommates at Dartmouth College which are randomly assigned to rooms. In this way, it implies that roommates' background characteristics are uncorrelated with own background characteristics. Duflo, Dupas and Kremer (2008) measure the impact of tracking in Kenya using a randomized evaluation. First, they retain 121 schools for the experiment. Then, in 60 randomly selected schools, students were randomly assigned to classes. In the remaining 61 schools, students were ranked by prior achievement (measured by their first term grades) and the top and bottom students of the class were assigned in different sections. After 18 months, they compare students' performances between both groups. However, logistical, ethical, political and economic reasons explain generally why such experiments may not be feasible in most social and educational studies (Titus, 2007).

3. Empirical framework

Compulsory school in Switzerland is divided into a primary level (around six years) and a lower secondary level (around three years). No ability tracking occurs at primary level while different types of educational programs are proposed at lower secondary level, often based on cultural and historical factors. In Switzerland, pupils can be tracked between or within lower secondary schools. In order to make clear distinctions among the different types of students, we consider the school track they follow. Mostly, we can identify three school tracks: higher-requirement tracks (pro-gymnasium) contain students who follow more advanced courses and prepare them for gymnasium (i. e. academic maturity) whereas middle- and lower-requirement tracks prepare students for an apprenticeship or a vocational education (e. g. professional maturity). By definition, when students are tracked at the school level, we find only one ability track per school. When tracking within schools occurs, two schooling systems can be considered. The first consists of tracking students at the school track level. It is what we call *tracking* in a strict sense. Courses and teachers differ among the school tracks. The second is called *streaming*. In such a case, students with varying abilities are integrated into heterogeneous tracks but follow differentiated-ability courses in some major domains (e.g. mathematics). Students are then sorted to one track or the other depending on the domain subject to differentiation. The advantage of within school tracking is that moving from one track to another is more accessible than when tracking occurs between different establishments. Not surprisingly, the school and school track selection procedures are also based on heterogeneous practices regarding time and selection mechanisms. While school choice is more often (but not only) related to residential criteria[1], school track enrolment at the beginning of lower secondary school depends essentially on prior test performances, teacher recommendations and parental decision. Although selection decision can be taken on the basis of these three different criteria, in many cases parents appear to take the final decision (OECD, 2009). As a result, school track enrolment is then strongly correlated with parental educational preferences. The full model for estimating peer effects can be represented by the following equation:

$$Y_{istc} = \beta_0 + \beta_1 X_{istc} + \beta_2 Peer_{(-i)stc} + \beta_3 PeerAbility_{(-i)stc} + \beta_4 STC_{stc} + \varepsilon_{istc} \quad (1)$$

where Y_{istc} is the test performance of student i in school s, school track t and class c, X_{istc} is a vector of observable student characteristics, $Peer_{(-i)stc}$ are the average characteristics of peers, $PeerAbility_{(-i)stc}$ is the average outcome of the peers, STC_{stc} is a set of school or track or class characteristics and ε_{istc} an error term. The objective is now to deal with the different econometric difficulties presented in the previous section. In the current paper, I estimate contextual effects measured through the peer group economic, social and cultural status. Even controlling for simultaneity and multicolinearity, unobserved confounding factors (e. g. parental taste for schooling or student motivation) may still influence the peer group composition and lead to biased estimates. Consequently, students are not randomly allocated to either schools or school tracks and estimates will be upward biased. In order to deal with endogenous sorting, I introduce a large set of dummy variables which represent each school and each cantonal school track. Equation (2) corresponds to the reduced-form model incorporating school and cantonal school track specific components:

$$Y_{istc} = \beta_0 + \beta_1 X_{istc} + \beta_2 Peer_{(-i)stc} + \beta_3 C_{stc} + \underbrace{u_s + u_t + v_{istc}}_{\varepsilon_{istc}} \quad (2)$$

where C_{stc} is vector of class characteristics, u_s and u_t are respectively a school and a cantonal school track specific component and v_{istc} an idiosyncratic error term. By considering u_s and u_t as fixed, my identification strategy relies on school and cantonal school track fixed effects.

I lead a complementary analysis to account for equality of opportunity. My objective here is to analyze the influence of class heterogeneity on schooling opportunities regarding the students' family background. Based on the studies from Schuetz and al. (2008) and Raitona and Vona (2010), equation (3) regress the individual outcome on a proxy for family background, peer quality measures, a set of individual and school covariates and a set of interactions terms:

[1] Among all countries participating to the 2006 PISA international survey, Switzerland has the lowest competition among lower secondary schools. Indeed, 80% of the interviewers indicate that location is the main criterion in the schooling choice. As spatial segregation is rather strong in Switzerland, this explains why social and cultural composition of school is rather homogenous. Such tendency penalizes students with disadvantaged background that are grouped together. A potential solution would be to adopt a housing policy that would aim to develop social mix in different areas (OFS, 2007).

$$\begin{aligned}Y_{istc} = \gamma_0 + \gamma_1 FB_{istc} + \gamma_2 Peer_{(-i)stc} * FB_{istc} + \gamma_3 PeerHet_{(-i)stc} * FB_{istc} \\ + \gamma_4 X_{istc} + \gamma_5 STC_{stc} + \gamma_6 X_{istc} * FB_{istc} + \gamma_7 STC_{stc} * FB_{istc} + \varepsilon_{istc}\end{aligned} \quad (3)$$

where FB_{istc} is my proxy for family background characteristics and $PeerHet_{(-i)stc}$ the standard deviation of the peer quality variable. Interactions between family background and all explanatory variables presented in equation (3) are included in order to control for the factors that might affect the family background effect. School and school track fixed effects (or schools characteristics like admission procedures or school types) are not included in such specification because the family background effect has to be purged from any effects related to parental influence on school and school track access. The coefficients of interest are γ_2 and γ_3 which link educational attainment, family background and peer effects.

The Program for International Student Assessment (PISA) is an internationally standardised assessment of knowledge and skills acquired by students at the end of compulsory education initiated by the OECD. At each wave, a major field (reading, mathematics or sciences) is examined in depth. Switzerland takes the most of the PISA international questionnaires to generate complementary samples. Contrary to the *international sample* (according the terminology adopted by the Federal Statistical Office – FSO) from the OECD which focuses only on 15-year-olds students, the PISA Swiss *national sample* from the FSO/IRDP is composed of students attending exclusively the ninth grade whatever the age of the student. This national sample is particularly well-adapted for national and regional analysis because it contains rich information at the student, class, school track, school and canton levels[2]. In this paper, I use the wave 2006 of the PISA national sample where schooling performances are measured for reading, mathematics and sciences with a particular emphasis on the later. The national survey has been investigated in 15 Swiss cantons. Summary statistics are presented in Table 1. Student's performances are measured through PISA plausible values. Plausible values are constructed on the basis of observed item responses because each student answers different questions with different difficulties. PISA contains different plausible values that cannot be aggregated together to find a mean. As it is usually done in previous literature, I use the first plausible value. The scale of cognitive skills has been standardized at the OECD level with an average of 500 points and a standard deviation of 100 points. The peer group quality variable is measured by the economic, social and cultural status of the classmates. This variable is derived from variables related to parental education, parental occupational status and an index of home possessions (desk for study, educational software, books, computer, calculator, etc.). Parental expectation is also included in the regression to reduce the unobserved heterogeneity related to parent's educational preferences. Importance attached by the parents to the field considered is also taken into account. The

[2] The international sample does not give information at the class level. It is why researches using international PISA database analyze peer effects only at the school level (i. e. schoolmates' influence).

other individual covariates are gender, immigration status and the own economic, social and cultural status. School and class characteristics are also presented in Table 1.

Table 1

Summary statistics

Variables	Description	Mean	Standard deviation
Score in sciences	Standardized test scores (mean: 500 points / sd: 100 points)	514.615	85.293
Score in mathematics	Standardized test scores (mean: 500 points / sd: 100 points)	539.330	84.041
Score in reading	Standardized test scores (mean: 500 points / sd: 100 points)	505.979	80.409
Female	=1 if female	1.494	0.500
Parental expectation	=1 if expectation is higher education graduated	0.395	0.659
Escs	Economic, social and cultural status OECD average = 0, standard deviation = 1 point	0.187	0.870
Parent value (sciences)	= 0 if not important, =1 if important	0.580	0.544
Parent value (mathematics)	= 0 if not important, =1 if important	0.952	0.300
Parent value (reading)	= 0 if not important, =1 if important	0.945	0.291
Immigration status	=0 if native, =1 if immigrant, =2 if immigrated parents	0.378	0.728
Peer	Mean parental occupational status in the peer group	0.186	0.410
Peer heterogeneity	Standard deviation of parental occupational status in the peer group	0.816	0.185
Student-teacher ratio	Number of teachers in the school divided by school size	11.000	4.067
Size of the school	Sum of the number of boys and girls in the school	559.888	306.976
% of teachers with university degree	Number of ISCED 5A teachers divided by number of teachers	0.556	0.401
School community	=1 if village, =2 if small town, =3 if town, =4 if city	2.397	0.804
Size of the class	Size of the class	20.853	4.307
Number of classes =762 Number of school tracks = 41 Number of schools =232 Number of observations (N) = 12’943			

It is important to precise that cantonal school track dummies represent the track level in a given canton. In fact, controlling for the cantonal school track allows me to account for specific cantonal characteristics in my estimates.The analytical sample size is reduced for satisfying fixed effects specification because this approach exploits a variation in the subgroup composition (i. e. class level) within fixed-effects groups (i. e. school and cantonal school track level). To avoid that fixed effect methods absorb any variation at fixed-effects groups level, we have to ensure that there are at least two classes per school and cantonal school tracks. Moreover, classes with less than six students are excluded from my analysis. To maintain this structure, it is preferable not to drop individuals with missing values (excepted for the variables related to peers' measures and test scores). I adopt then the following strategy. For categorical data, I treat missing data as just another category. For continuous variables, I plug a zero for all missing data cases and then I include in the regression a dummy variable indicating if the variable has been plugged or not. This type of dummy serves as a missing data indicator. Finally, pupils in a given track are more likely to be more similar than those belonging to other tracks. We suspect then an intra-group correlation between students from the same school track. In such case, the *iid* assumption for the error terms is not verified anymore. I account for this situation by clustering my standard errors at the school track level.

4. Results

Average peer effects in sciences, mathematics and readings are reported in Table 4. First of all, we can observe positive, strong and significant average peer effects in sciences and readings. The fact that we do not find significant peer effects in mathematics is maybe related to the primordial importance of the teacher in this field. However, we cannot verify this hypothesis in the present paper because we have not the possibility to control for teacher specific effect. Coefficients related to parental expectation and own economics, social and cultural status follow the expected signs. The value attached by parents to reading and sciences influences strongly the score obtained by the children in these fields but it is not the case for mathematics. A potential explanation may reside on the fact that parental interest for environmental considerations or literacy can be more easily transmitted to children than interest for mathematics. Similarly to previous studies, males perform better in sciences and mathematics whereas females obtain better results in reading. The variable «Immigration status» indicates us that natives obtain higher test scores than children with migration background. Finally, the size of the class is negatively associated with schooling performances in reading and sciences. Until now, we have shown that average peer effects exist and are relatively strong. What is then the mean impact of class heterogeneity on student's performances? For this purpose, I introduce the standard deviation of the peer variable in order to account for class heterogeneity (results not reported here). We find that mixing students with different economic, social and cultural status could influence negatively overall schooling achievement but coefficients are weaker that those obtained for peer effects and insignificant. However, the policy relevance of average peer effects is rather limited. To discuss schooling policies, we have to consider asymmetric peer effects in order to know which kinds of students benefit most from peer effects. For this purpose, I introduce the interaction term between the peer quality variable and the own economic, social and cultural status (results not reported here). A negative (positive) coefficient of the interaction term indicates that pupils with low (high) socio-economic status are more sensitive to the peer group's influence. Results seem to indicate that students with higher parental background benefit most from peer effects. But again, coefficients are relatively low and not significant.

Table 2

Average peer effects

Dependent variable	Sciences test score	Mathematics test score	Reading test score
Explanatory variables	*Coefficients (robust s.e.)*	*Coefficients (robust s.e.)*	*Coefficients (robust s.e.)*
Female	-18.331*** (1.617)	-24.606*** (1.725)	16.681*** (1.548)
Escs	9.305*** (1.280)	8.412*** (1.125)	6.738*** (1.130)
Native (reference category)			
Immigrant	-26.861*** (2.353)	-20.778*** (2.396)	-19.614*** (2.537)
Immigrated parents	-43.476*** (2.589)	-36.036*** (2.931)	-34.904*** (2.701)
Parent value	11.631*** (1.899)	-2.030 (2.221)	8.014*** (1.890)
Parental expectation	21.536*** (3.793)	18.415*** (3.553)	17.033*** (3.606)
Peer	9.023* (4.705)	4.881 (4.607)	9.103** (4.095)
Class size	-0.331*** (0.021)	0.082*** (0.021)	-0.460*** (0.021)
Constant	610.286*** (5.306)	634.285*** (5.779)	546.290*** (4.900)
R-squared	0.451	0.438	0.401
N	12'943	12'943	12'943

*, ** and ** indicate a statistical significance at 10%, 5% and 1% level respectively
Robust standard errors clustered at the school track level.
School and School track dummies are used for school and school track fixed effects

Not satisfied by these results, I adopt an alternative strategy to account for asymmetric peer effects. Similarly to Rangvid (2004) and Schneeweis and Winter-Ebmer (2007), I use a quintile regression to analyze peer effects at different quintiles of the conditional test score distribution. Results are presented in Table 3 and suggest clearly that peer effects are stronger for low-ability students in all domains. How to interpret these results? As low achievers benefit substantially from peers' quality, proponents of comprehensive systems have then a potential strong argument to defend their viewpoint. Nevertheless, we have to verify if mixing student lead to some adverse effects on student's performances. In Table 3, by looking on the coefficients of the peer heterogeneity variable, we can see that the impact of class heterogeneity becomes positive at the right side of the distribution.

Table 3

Asymmetric peer effects – A quintile regression approach

	Quintile				
	Q=15	Q=25	Q=50	Q=75	Q=85
Dependent variable	**Sciences test score**				
Peer	10.106*** (4.540)	9.670** (4.573)	9.724** (4.534)	5.271 (5.601)	2.280 (4.882)
Peer heterogeneity	-1.386 (7.497)	-6.245 (6.328)	-4.435 (5.301)	-0.463 (7.544)	0.806 (7.593)
Peer*escs	0.899 (3.034)	0.904 (2.427)	-0.193 (1.392)	0.631 (1.918)	2.569 (3.271)
R-squared	0.283	0.282	0.273	0.265	0.262
Dependent variable	**Mathematics test score**				
Peer	9.683** (4.822)	2.505 (4.926)	3.361 (3.925)	4.873 (4.720)	2.942 (3.497)
Peer heterogeneity	-2.262 (6.763)	-0.664 (2.322)	-3.667 (5.711)	-0.076 (6.096)	1.944 (1.610)
Peer*escs	-0.255 (2.811)	-0.241 (6.394)	0.167 (2.053)	1.880 (1.807)	-2.910 (6.710)
R-squared	0.266	0.264	0.263	0.260	0.257
Dependent variable	**Reading test score**				
Peer	12.399** (6.011)	13.912*** (4.324)	10.789** (4.222)	4.382 (4.490)	-1.494 (4.626)
Peer heterogeneity	1.625 (9.305)	-5.432 (7.894)	-6.228 (5.335)	-4.802 (4.860)	6.795 (4.408)
Peer*escs	1.164 (2.942)	0.741 (2.169)	0.260 (2.403)	-1.583 (3.218)	-1.419 (3.185)
R-squared	0.255	0.250	0.234	0.223	0.220
N	12'943	12'943	12'943	12'943	12'943

*, ** and ** indicate a statistical significance at 10%, 5% and 1% level respectively
School and School track dummies are used for school and school track fixed effects

This could indicate that high-ability students take advantage of their higher cognitive skills to perform better in a heterogeneous environment or because they benefit from the «learning by teaching» effect (Bereiter and Scardamalia, 1989; Webb and al., 1997): by adopting a teacher role in the class, clever students can increase and solidify their understanding of the material by explaining it to low- and middle- ability students. Here, however, low-ability students do not seem benefit from these explanations. Why? We can assume that the cognitive gap between low- and high-ability children is too wide. The former do not have not sufficient cognitive abilities to understanding explanations from the later (Mugny and Doise, 1978). In such a case, the advantage is only one-way and this situation does not speak in favor of reallocating students. But, as my coefficients are insignificant at both extremes of the distribution, this study cannot verify such hypotheses. Exploring more in details the «learning by teaching» effect can bring us some relevant pieces of information in the debate between tracking and mixing.

What about equity? Until now, we have only considered the efficiency effect of class heterogeneity on student achievement. Our findings suggest only partial evidence for efficiency gains regarding grouping policy. In this final part, we present a model largely inspired from Raitano and Vona (2010) which takes into account equality of opportunities. Results are presented in Table 4 where we find a positive, strong and significant coefficient for the interaction term between own economic, social and cultural status and the mean peer variable indicating that a higher peer average reinforces the influence of family background.

Table 4

Peer effects and schooling opportunities

Dependent variable	**Sciences test score**	**Mathematics test score**	**Reading test score**
Escs	22.803 (13.925)	25.937* (14.870)	16.511 (12.544)
Peer*escs	14.302** (5.428)	12.729** (5.414)	13.437** (5.135)
Peer heterogeneity*escs	-5.849 (5.443)	-9.204* (5.348)	-3.057 (3.187)
R-squared	0.205	0.186	0.188
N	12’943	12’943	12’943

*, ** and ** indicate a statistical significance at 10%, 5% and 1% level respectively
Robust standard errors clustered at the school track level.
All models also control for: female, immigration status, parental expectation,
parental value, escs,teacheruni, ratio, size, school community, class size and interactions between all these previous variables and escs.

On the opposite, class heterogeneity seems to reduce the impact of background characteristics on student outcome. Coefficients obtained are negative, large but no significant excepted for mathematics. These results suggest that tracking students in mathematical courses ensures a social reproduction process (at least) in this field and decrease educational opportunities. Interestingly, both findings confirm the results obtained by Raitano and Vona (2010) that postulate that adopting a comprehensive system in Swiss lower secondary schools can increase schooling opportunities.

5. Conclusion

Peer quality is an important input for student outcome. Classmates influence each other by generating externalities. For example, positive spillovers result from constructive discussion with smart students whereas negative spillovers occur when disruptive children induce their comrades to be less attentive during the lesson. The magnitude and nature of such social interactions can give some insights concerning the optimal allocation of students to classes. In the present study, I obtain positive, strong and significant average peer effects in readings and sciences indicating that classmates in these fields contribute to the individual learning process. Peers' influence is not significant in mathematics. This result is generally explained by the fact that teacher's influence is of primary importance in mathematics learning. Peer effects theory considers two main arguments in favor of grouping various-ability students: heterogeneity in the student body does not produce negative effects on average student achievement and low-ability pupils benefit more from peer effects than clever students. For this purpose, however, we need rather to focus on asymmetric peer effects which give more relevant policy information. Our empirical findings cannot give clear recommendations regarding a possible reallocation of students into heterogeneous tracks without differentiation. The influence of class heterogeneity on student outcome is inconclusive. If mixing students will serve at first high-ability students, this schooling policy is then not adapted to student's needs. However, two arguments speak in favor of adopting a comprehensive system. First, low achievers benefit strongly and significantly from peer effects and secondly, class heterogeneity seems decrease the impact of family background, especially in mathematics. In brief, there are no strong arguments for changing the present Swiss tracking system. However, selection decisions should be more reliable and transparent if we want that the Swiss tracking system increase educational output and opportunities equalization.

The major limitation of this study (and a lot of previous papers) is that we cannot account for the fact that teacher changes their behavior when they teach in high- or low-ability tracks. Indeed, while teachers in high-ability tracks focus on the material to be taught, the objectives of teacher in low-ability tracks are to keep their students well-behaved and interested. Teacher behaviors and the role of high-ability students in mixed classes may be an interesting starting point for future research in economics of education.

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