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Peer Effects, Social Multipliers and Migrants at School: An International Comparison

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Peer Effects, Social Multipliers and Migrants at School: An International Comparison[1] (REVISED VERSION)

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Abstract: This article analyses the school performance of migrants dependent on peer groups in different international schooling environments. Using data from the international OECD PISA test, we consider social interaction within and between groups of natives and migrants. Results based on social multipliers (Glaeser et al. 2000, 2003) suggest that both native-to-native and migrant-to-migrant peer effects are higher in ability-differencing school systems than in comprehensive schools. Thus, non-comprehensive school systems seem to magnify the already existing educational inequality between students with a low parental socioeconomic migration background and children from more privileged families. Students with a migration background and a disadvantageous parental status would benefit from higher diversity within schools.

Key words: Peer effects, migration, education, social multipliers, school systems, parental socioeconomic background

JEL Classification: I21

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Introduction

An important strand of the debate on immigrant integration has revolved around the apparently poor school performance of children with immigration backgrounds. This is often attributed to poor language skills, a disadvantaged socio-economic background, or other socio-cultural factors impeding educational achievement. The debate has been given renewed impetus by the results of the Programme for International Student Assessment (PISA). In fact, these data reveal that the performance of children with a parental migration background differs strongly across countries. The reasons for these internationally differing performances of migrant students are not clear and rarely discussed in the literature. Most of the existing contributions focus on the relatively poor socio-economic background of migrants (see, among others, Gang and Zimmermann 2000; Frick and Wagner 2001; Ammermüller 2005). In some countries, the parental effect on the schooling performance of children is reinforced by a particularly low intergenerational educational transmission. Entorf and Minoiu (2005) show that for both migrants and non-migrants so called socio-economic gradients, i.e. the degree of intergenerational correlation, are relatively high in Germany, the UK and the US, whereas they are much smaller in Finland, Sweden and Canada. Stanat (2003) and Baumert et al. (2003) argue that in almost no other country do social and ethnic background appear to determine student achievement as much as in Germany. Van Ours and Veenman (2003) and Bauer and Riphahn (2007) compare the intergenerational education transmission of natives and immigrants in the Netherlands and Switzerland, respectively. Bauer and Riphahn (2007) show that the socioeconomic gradient for (second-generation) immigrants is lower than for natives (among immigrants, after controlling for various characteristics, the probability of high education among those with poorly educated parents is only one third of those with well educated parents, whereas the same ratio is even only one sixth for natives). Van Ours and Veenman (2003) find that natives and immigrants do not differ in intergenerational education transmission. Results in Entorf and Minoiu (2005) reveal that the very high PISA scores of migrant students from the traditional countries of immigration Australia, Canada, and New Zealand are not surprising given the high socio-economic status of selected business migrants in these countries.

However, a comparatively neglected factor which seems highly relevant for cross-sectional comparisons is the impact of schooling systems. Some authors discuss whether, in addition, the early tracking into different-ability schools at age 10 as in Austria and Germany might have consequences for efficiency and distribution of educational outcomes (see Dustmann, 2004, for a critical assessment of the selective German school systems, and

Hanushek and Wössmann, 2006, for recent econometric evidence). Educational researchers argue that the system of early differentiation by skill level has a negative impact on the school performance of children who come to school with language and social deficits, a high proportion of whom come from families with a migration background. Early division may not provide these children with necessary basic skills before they are separated into better or weaker school systems.

It thus seems that the school performance problems faced by immigrant children from socially less advantaged families are exacerbated by schooling systems. However, theory is inconclusive about the impact of tracking on both the level and distribution of schooling outcomes (see Doppelsteen *et al.* 2002; Epple *et al.* 2002; Brunello and Giannini 2004; Meier 2004; see Hanushek and Wössmann 2006 for a survey of the main arguments of this literature) and predictions of the overall effect of schooling systems seem to depend on the social interaction between high and low ability students and resulting peer effects. On the one hand, if individuals are better off with peers of their own ability level, ability grouping could improve the level of performance. On the other hand, heterogeneous classrooms might give rise to efficiency because less gifted students benefit from the social interaction with high ability peers.

Given its importance for individual student achievements, it is not surprising that there is a rapidly growing literature on peer effects and social interaction in schooling (Hoxby 2000; Sacerdote 2001; Levin 2001; McEwan 2003; Hanushek *et al*. 2003; Robertson and Symons 2003; Winston and Zimmerman 2003; Angrist and Lang 2004; Lalive and Cattaneo 2004; Frölich and Michaelowa 2005; Fertig 2003; and Schneeweiss and Winter-Ebmer 2005), with the latter two articles especially dealing with PISA data. Most of the aforementioned studies find significant peer effects.

In this article we investigate the role that social integration of migrants plays for their schooling achievements in selected nations. More specifically, we estimate and compare peer effects based on the idea of social multipliers (Glaeser and Scheinkman, 2000; and Glaeser *et al.* 2003) for migrant and non-migrant students and study the impact of social interaction on PISA scores. If insufficient integration is a problem, social interaction will mainly take place within the group of migrants on the one hand, and within the separated group of natives (and not across these groups) on the other hand, and we would expect that such a form of segregation would lead to strong migrant-to-migrant peer effects, whereas the native-to-migrant effect would be expected to be low (analogous results should be observed for native-to-native and migrant-to-native peer effects). As argued above, the question of peer effects

cannot be disentangled from the influence of prevailing national schooling systems. We test the hypothesis that early tracking reinforces segregation effects such that migrants in nations such as Austria and Germany, who mainly attend the lowest-level secondary school (e.g. the German *Hauptschule*), should receive relatively few benefits from separated high-ability natives of the same age. This would lead to adverse peer effects in the sense that prevailing differences between children from families with a disadvantaged (migration) background and more advantaged families would be amplified. Our results confirm this hypothesis.

This article is organised as follows. The next section presents the theoretical framework for analysing social multipliers. After presenting the data in the following section, we go on to describe the degree of educational segregation for several groups of countries. Econometric results and resulting direct and indirect social multipliers are then presented, and the final section summarises results and provides some conclusions.

Identification of Peer Effects and Social Multipliers

Econometric research on the identification of peer effects has been strongly influenced by Manski's (1993, 1995, 2000) work on the social reflection problem and endogenous effects (see also Radu's discussion of Manski's concept in this volume). The existence of positive externalities from social interaction requires that individual student *i*'s achievement will improve the achievement of student *j*, and that this impulse will propagate throughout the class-room or school, finally leading to a multiplier effect of the exogenous change. Theoretical research by Glaeser and Scheinkman (2000) and Glaeser *et al*. (2003) focuses on the identification of these so called 'social multipliers' and their dependence on segregation. Sacerdote (2001) has applied this approach and found significant multiplier effects for Dartmouth roommates.

Extending the basic framework of Glaeser *et al*. (2000, 2003) to a two-equation system, we estimate the impact of student achievements of peer groups on individual PISA scores and calculate resulting social multipliers. Potential asymmetries between migrants and natives are considered by estimating effects in separate group-specific regression equations. Each (migrant or native) student can be influenced by the average achievements of both peer groups, i.e., from both migrants and natives.

Peer effects and multipliers depend on the social background of peer groups and thus on the migrant population and schooling systems. We therefore employ evidence from different groups of countries to study the heterogeneity of peer effects in response to national peculiarities. We select four different groups: a) traditional countries of immigration with

highly qualified 'business migrants': Australia, Canada, New Zealand; b) countries of 'labour migration' and non-comprehensive school systems: Austria, Germany; c) countries of 'labour migration' and comprehensive school systems: Denmark, Sweden, Norway; d) countries of Central and Eastern Europe: Czech Republic, Hungary, Russia.

Individual PISA scores of migrants and natives are modelled as

$$
\begin{aligned}
P^m_{i_s s} &= \beta^m{}' X_{i_s s} + \delta^m{}' R_s + \gamma^m_m \bar{P}^m_s + \gamma^m_n \bar{P}^n_s + \varepsilon^m_{i_s s}, \\
P^n_{i_s s} &= \beta^n{}' X_{i_s s} + \delta^n{}' R_s + \gamma^n_m \bar{P}^m_s + \gamma^n_n \bar{P}^n_s + \varepsilon^n_{i_s s},
\end{aligned}
\tag{1}
$$

where

s = $1, \cdots, S$, S = number of schools in national sample

i_s = $1, \cdots, n_s$, n_s = number of students at school s

$P^m_{i_s s}$ = PISA score of migrant student i_s at schools s

$P^n_{i_s s}$ = PISA score of native student i_s at schools s

$X_{i_s s}$ = vector of student-specific explanatory variables

R_s = vector of school-specific factors ('resources') at school s

$\bar{P}^j_s$ = average PISA score for schools, disregarding contribution of i_s, $j = m, n$.

$\beta_m, \beta_n, \delta_m$ and δ_n are estimated coefficients identifying the effects of student and school characteristics. Peer effects are estimated at the school level (PISA data do not include class identifiers). The parameters γ^j_k, $j, k = m, n$, measure the degree of social interaction. The higher γ^j_k is, the larger the impact of the respective average peer group on individual achievements. In econometric estimations, averages $\bar{P}^j_s$, $j = m, n$, are calculated without the individual contribution of the endogenous achievement of student i_s. Equation (1) is estimated for migrants and natives of all four country groups presented above.

Equation (1) follows along the lines of Manski (1993, 1995, 2000) and Glaeser et al. (2000, 2003), who provided the theoretical framework for the description and identification of social interaction and social multipliers. Manski has drawn attention to the fact that individual behaviour not only reacts to exogenous individual characteristics of the individual herself, but also to actions and characteristics of other individuals in the relevant group in which interaction takes place. In more detail, Manski distinguishes between exogenous individual effects, endogenous effects, correlated exogenous group effects and correlated environmental

effects. Applied to schooling problems (see also Cipollone and Rosolia 2003; Lalive and Cattaneo 2004; Schneeweiss and Winter-Ebmer 2005), exogenous individual effects arise due to characteristics such as gender, parental income or education. Endogenous effects are described by the process of social interaction: student achievement depends positively on the average achievement of the peer group. Obviously, omitting average achievements in regressions of student achievements would cause an omitted variable bias. However, including the result of the peer group might lead to a classical simultaneity bias because the result of the group is influenced by the achievement of the student in question. Thus, there is a trade-off between two potential sources of biases. As we are mainly interested in estimating social multipliers and parameters of social interaction, we need to include the student achievements of peer groups (see Glaeser *et al.* 2000, 2003, see also below). As a consequence, we have to omit exogenous group averages from our regression model because they would be perfectly collinear with the achievement of the peer groups (see, for instance, Manski 1995). Inclusion of observed mean group achievements allows us to control for unobserved group effects such as the general level of empathy within classes, delinquent peers, attention and support from parents, pedagogical talents of parents, and so on. To reduce the problem of simultaneity, we calculate average peer group achievements by omitting the contribution of student *i* to the peer group average.

Correlated environmental effects arise because students share similar environments such as common teachers, schooling resources or geographical location. Unlike group effects stemming from averaging individual exogenous effects, correlated environmental effects hint at factors common to all students of a group as a source of within-group homogeneity and between-group heterogeneity.

Econometric results might also suffer from some sorting bias. This arises when students (or their parents) select themselves into schools and peer groups. If a sorting process leads better students to choose better schools, peer effects might be overestimated. We try to reduce this bias by controlling for rich information on students' individual family backgrounds, i.e. by considering observable causes of sorting, and by including school-specific effects such as student-teacher ratios, share of students with a migration background or variables indicating some school-specific problem with command of national languages. Moreover, we have carried out robustness checks by running the same regressions as reported in Table 2 (see below) omitting schools which are identified to select students on the basis of performance measures (or by residence). Of course, in the case of Germany, for instance, the best way of

avoiding the sorting bias would be to control for types of school (i.e. *Hauptschule*, *Realschule* and *Gymnasium*). Unfortunately, this information is not available.

The identification of social multipliers is possible by aggregating individual results within groups, i.e. schools (see Glaeser *et al.* 2000, 2003). Assuming that average peer group achievements are calculated including student i_s as an approximation, aggregation of both individual migrant and native students within schools leads to:

$$\bar{P}_s^j = \beta^j{}' \bar{X}_s + \delta^j{}' R_s + \gamma_m^j \bar{P}_s^m + \gamma_n^j \bar{P}_s^n + \bar{\varepsilon}_s^j, \qquad j = m, n. \tag{2}$$

Solving each equation individually and assuming that average residuals are zero, we obtain the following two-equation system, where we omit the school index for reasons of simplicity:

$$\begin{aligned} P^m &= \frac{1}{1-\gamma_m^m}\left(\beta_m \bar{X}^m + \lambda_m R + \gamma_n^m \bar{P}^n\right) \\ P^n &= \frac{1}{1-\gamma_n^n}\left(\beta_n \bar{X}^n + \lambda_n R + \gamma_m^n \bar{P}^m\right) \end{aligned} \tag{3}$$

Solving this two-equation system for P^m and P^n, we obtain

$$\begin{aligned} \bar{P}^m &= M^m\left(\beta_m \bar{X}^m + \lambda_m R\right) + \gamma_n^m M^n\left(\beta_n \bar{X}^n + \lambda_n R\right) \\ \bar{P}^n &= M^n\left(\beta_n \bar{X}^n + \lambda_n R\right) + \gamma_m^n M^m\left(\beta_m \bar{X}^m + \lambda_m R\right) \end{aligned} \tag{4}$$

where M^j, $j = m, n$, represent the group-specific social multipliers arising through social interaction among members of the same group j and between members of both groups, i.e. between migrants and natives:

$$\begin{aligned} M^m &= \left(1-\gamma_m^m - \frac{\gamma_n^m \gamma_m^n}{1-\gamma_n^n}\right)^{-1}, \\ M^n &= \left(1-\gamma_n^n - \frac{\gamma_m^n \gamma_n^m}{1-\gamma_m^m}\right)^{-1}. \end{aligned} \tag{5}$$

As can be seen by comparing equations (3) and (5), group-specific multipliers boil down to $(1-\gamma_j^j)^{-1}$, $j = m, n$, when no impact from the other group exists (this case has been studied by Glaeser *et al.* 2000, 2003). Magnified by their respective social multipliers, student-specific and school specific explanatory variables have both direct and indirect effects on average PISA scores of migrants and natives. Inspecting equation (4), the direct (primary) impact is represented by the first summand mainly resulting from interaction *within* respective groups, whereas the respective indirect impact of, for instance, native students on migrant students can be followed from the second summand of the migrants equation. The size of the indirect (secondary) effect depends on the product of a) γ_k^j, i.e. the degree of social interaction

between migrants and natives, and b) the size of the primary effect within the respective other (second) group.

Data

As explained in more detail elsewhere (in particular, OECD 2001), the Programme for International Student Assessment (PISA) is a joint effort among member countries of the Organisation for Economic Co-operation and Development (OECD) to assess the achievement of 15-year-olds in reading literacy, mathematical literacy and scientific literacy through a common international test. PISA defines reading literacy as the ability to understand, use and reflect on written texts in order to participate effectively in life. PISA is a three-phase study with the first phase in 2000, the second in 2003 and the third in 2006. In 2000 the main domain assessed was reading literacy. Mathematical literacy and scientific literacy were minor domains assessed in a sub-sample of reading-literacy participants. More than 250,000 students took part in PISA from the 32 participating countries (the Netherland's results are not included in the final report and four non-OECD countries participated). A minimum of 150 schools and 4,500 students were selected in each country according to the sample design prepared by OECD scientists (see Krawchuk and Rust 2002).

Characterisation of Migrants and Segregation Across Schools: International Evidence

To cover the heterogeneity of schooling systems and types of migrants, we selected data from 11 countries. A first group of countries consists of the traditional countries of immigration Australia, Canada and New Zealand. These countries follow an immigration policy that seeks to admit selected applicants with high education, good language skills and the flexibility to contribute to the countries' human resources by quickly and efficiently matching their skills with opportunities in these countries. Given the high percentage of well educated migrants and existing intergenerational correlation of educational attainments, it is perhaps not surprising that these three countries ranked second (Canada), third (New Zealand) and fourth (Australia) in the ranking of the overall scores of the OECD PISA 2000 reading test (see Entorf and Minoiu 2005, for the importance of immigration policy in these countries in influencing schooling achievements).

The second group consists of 'Scandinavia', represented by Denmark, Norway and Sweden in our data set. The schooling system in these countries is different from the one in Austria and Germany, which represent our third group of countries. Whereas Scandinavian

countries keep their entire secondary-school system comprehensive, Austria and Germany track students into different ability schools. Here selection takes place by age 10.[1)] Migrants in both groups of countries can be characterised as 'labour migrants' with a relatively low socioeconomic status as opposed to 'business migrants' in the traditional countries of immigration (see Entorf and Minoiu, 2005).

The Czech Republic, Hungary and Russia are combined in a fourth group representing countries from Central and Eastern Europe. Here, migratory trends have quickly been shifting towards those typical of the developed western world. Romanians, Slovaks, Ukrainians, Vietnamese and Poles are the most important source countries of immigration to the Czech Republic and Hungary (see IOM 2004, Juhasz 2003), whereas the influx of ethnic Russians from eastern states (Kazakhstan, eastern Ukraine, Uzbekistan and Kyrgyzstan) and Baltic states (Estonia, Latvia) of the former Soviet Union form the majority of migrants to Russia (Heleniak 2002). However, although immigration problems are increasingly important in these countries, the share of migrants is still small relative to the share in the other groups (see Table 1).

In advance of presenting estimation results, Table 1 gives some descriptive information on migrants, their schooling achievements (PISA reading literacy) and the degree of educational segregation across schools. The share of migrants (defined as students both of whose parents were born abroad) in selected western countries ranges between 4.6% in Norway and 22.6% in Australia, whereas ratios in Eastern and Central Europe range between 1.0 per cent and 4.2 per cent. The share of migrants in traditional countries of immigration is significantly above the share of migrants in all other countries.

The selective immigration mechanism prevailing in Australia, Canada and New Zealand leads to a parental socio-economic background of migrants (measured by ISEI, i.e. the International Socio-Economic Index of Occupational Status, see below) that is comparable or even higher than the socio-economic background of natives (see column three of Table 1). Given the general intergenerational transmission of education, it is thus not surprising that for this group of countries differences in PISA scores between migrant and native students are smaller than in western European countries of 'labour migration'. Within the latter groups, migrants from countries with non-comprehensive systems (Austria, Germany) have lower average scores (differences are below –80.0) than migrants in comprehensive Scandinavian schooling systems (differences range between –56.7 and –79.3). However, once again, comparisons between groups are biased without considering the different socioeconomic background of parents. Measured in terms of ISEI, immigrants in Scandinavia have a

significantly smaller socio-economic gap relative to natives than in Austria and Germany. PISA scores of migrants in Eastern and Central Europe, finally, do not differ much from the performance of natives, with the slight exception of the Czech Republic.

Segregation and high clustering of migrants in neighbourhoods might have a negative impact on immigrants' educational achievement since there is less social interaction with natives than in mixed environments. Pupils are likely to be influenced by their peers' school ambitions and these are likely to be different in highly segregated schools. We follow Schnepf (2004) in calculating what she dubbed 'school segregation'. It measures the distribution of immigrants and natives across schools and is calculated according to the Duncan (Duncan and Duncan, 1955) segregation index of dissimilarity. Its formula is as follows:

$$DIS = \frac{1}{2}\sum_{s=1}^{S}\left|\frac{M_s}{M_{country}} - \frac{N_s}{N_{country}}\right|100\,, \tag{7}$$

where *s* refers to the school and 'country' to the average result in the country. M measures the number of migrants in the respective school or country and N the number of natives in the respective school or country. DIS ranges between 0 and 1. It can be interpreted as the fraction of migrant students that would need to be moved to different schools in order to achieve equal distribution of migrants across all schools in the country. In line with Schnepf (2004), DIS is high in most countries. More than 50 % of immigrants in all countries except Australia would need to be shifted to different schools to achieve proportional representation in all schools. DIS is lowest in Australia, but here DIS is still about 48. The highest ratio can be observed for the Czech Republic although the reliability of this figure is uncertain given the small share of migrants in this country. Summing up, 10 out of 11 countries have a dissimilarity index above 50, confirming Schnepf's (2004) conclusion that migrants' integration into national educational systems appears to be rather limited.

A further indicator of segregation is the allocation of migrant students to top or bottom ranked schools, as measured by average PISA scores (see also Schnepf, 2004, for a different set of countries). Due to the highly different recruitment processes for immigrants, traditional countries of immigration provide a strong contrast to the remaining group of countries. Table 1 reveals that in Canada 15.4 per cent of migrant students attend schools of the top 10 percent level, whereas in Germany this is only the case for 4.5 per cent of all migrants. As regards the bottom 10 percent of schools, only 4.6 per cent of Canadian migrant students attend one, whereas 17.1 per cent of migrants in Germany attend them. In Scandinavia, too, a large fraction of migrant students is sorted into the bottom range of national schools. Here, shares

range between 15.7 per cent and 27.1 per cent. Top schools seem to be more easily accessible in Hungary, where 19.8 per cent of migrants attend them.

Table 1 Schooling, migrants and segregation: descriptive evidence for selected countries

	Share of Migrants (1)	Differences in PISA Scores (Migrants/ Natives) (2)	Differences in ISEI (Migrants/ Natives) (3)	Dissimilarity Index (Migrants) (4)	Ratio of all Migrants in Top 10%-PISA Score Schools (5)	Ratio of all Migrants in Bottom 10%-PISA Score Schools (6)	Ratio of Between School Variance of PISA Scores (7)
Australia	0.226	-12.553	-0.168	48.449	0.130	0.087	0.224
Canada	0.204	-11.805	2.539	61.017	0.154	0.046	0.200
New Zealand	0.194	-30.090	6.297	50.065	0.108	0.180	0.198
Denmark	0.061	-79.348	-4.746	62.832	0.072	0.228	0.212
Norway	0.046	-58.558	-4.684	58.056	0.063	0.157	0.144
Sweden	0.105	-56.728	-3.972	50.102	0.066	0.271	0.126
Austria	0.096	-80.035	-9.578	57.644	0.065	0.133	0.527
Germany	0.152	-82.851	-9.027	50.023	0.045	0.171	0.636
Czech Republic	0.010	-35.445	-5.248	81.854	0.028	0.130	0.562
Hungary	0.017	5.952	6.022	60.916	0.198	0.022	0.656
Russia	0.042	-8.060	0.373	51.521	0.092	0.069	0.393

Notes: Observations are weighted by student weights. 'Migrant' students are students whose both parents were born in a foreign country. 'Natives' refer to all other children. 'Top' and 'bottom' ranked schools are identified by ranking national school-specific PISA score averages and calculating percentiles.

The last column of Table 1 shows the decomposition of the PISA score variance into its between-school and within-school shares. Results reveal differences caused by characteristics of comprehensive versus ability-tracking schooling systems. The variance of PISA scores in Austria and Germany is mainly driven by the heterogeneity of abilities across different types of schools, whereas in comprehensive Scandinavian schools PISA performance mainly varies within schools. Whereas the share of variance between schools ranges between 0.527 and 0.636 in the different-ability group of countries, corresponding shares in Scandinavia range between 0.126 and 0.212. As in Scandinavia, classical countries of immigration also have relatively small ratios of between-school variance, which does not come as a surprise given

their comprehensive schooling system (as in Scandinavia, all three countries have one single school type available to 15-year-olds, see OECD 2004, p. 262, Table 5.20a). On the other hand, according to the same source (OECD 2004) students in the Czech Republic (five school types) and Hungary (three school types) are allocated to distinct ability levels, and the first age of selection in both education system is 11, such that the high ratio of between-school variance is indeed very close to that of Austria and Germany. [2)]

Summing up, the categorisation of countries into four groups that are rather homogeneous within their respective country group and heterogeneous across groups is confirmed by the descriptive evidence in Table 1, in particular with respect to student achievements, parental socio-economic status and the ratio of between-school variance.

Econometric Evidence and Estimation of Social Multipliers

The econometric modelling of individual PISA scores benefits from previous experiences with this data set in the literature (see, among others, Wößmann 2003, Fuchs und Wößmann 2004, Jürges und Schneider 2004, Entorf and Minoiu 2005, Ammermüller 2005, Schneeweiss and Winter-Ebmer 2005). The following individual characteristics as well as school-specific variables are included in the list of regressors of equations (1):

a) Individual characteristics and backgrounds of students
   - READING SCORE: Students' performance score in reading
   - FEMALE: Binary Dummy variable, which takes the value 1 if the pupil is female
   - GRADE_8: Binary Dummy variable, which takes the value 1 if the pupil attends 8th grade or lower
   - GRADE_9: Binary Dummy variable, which takes the value 1 if the pupil attends 9th grade
   - FOREIGN BORN: Binary Dummy variable, which takes the value 1 if the pupil is not born in the country of test
   - NATIONAL LANGUAGE AT HOME: Binary Dummy variable, which takes the value 1 if the pupil deploys mostly (the) national language(s) or other national dialects at home
   - LIVING WITH TWO PARENTS/GUARDIANS: Binary Dummy variable, which takes the value 1 if the respective pupil lives in a nuclear family or a mixed family (OECD 2000a: 30)
   - MORE THAN 100 BOOKS AT HOME: Binary Dummy variable, which takes the value 1 if the pupil reported having more than 100 books in his home

- HOME EDUCATIONAL RESOURCES: Index of home educational resources, derived from students' reports on the availability of a dictionary, a quiet place to study, a desk for study and the number of calculators at home. Positive values indicate possession of more educational resources and negative values indicate possession of fewer educational resources by the student's family (OECD 2000b: 224)
- HOMEWORK TIME: Index of time spent on homework, derived from students' reports on the amount of time dedicated to homework in the national language, mathematics and science (per week). Positive values indicate more and negative values indicate less time spent on homework (OECD 2000b: 226)
- ISEI: PISA International Socio-Economic Index of Occupational Status, derived from students' responses on parental occupation

b) School-specific factors

- STUDENT-TEACHING STAFF RATIO: Total number of pupils divided by the total number of teachers (whereby part-time teachers are counted as one half of a full-time teacher)
- QUALITY OF SCHOOL'S EDUCATIONAL RESOURCES: Index of the quality of the school's educational resources, derived from school principals' reports on lack of instructional materials, laboratory equipment etc. concerning the learning by 15-year-olds. Positive values indicate that the learning of 15-year-olds was not hindered by the school's physical infrastructure, and negative values indicate the perception that the learning of 15-year-olds was hindered by the school's physical infrastructure (OECD 2000b: 249)
- SPECIAL LANGUAGE COURSES AT SCHOOL: Binary Dummy variable, which takes the value 1 if the school principal reported on special training in national language for low achievers (concerning the group of 15-year-olds)
- VILLAGE/ SMALL TOWN: Binary Dummy variable, which takes the value 1 if the school is located in a village or a small town (up to 15,000 people)
- HOURS OF SCHOOLING PER YEAR: Index of hours of instructional time for 15-year-olds per year, derived from school principals' reports
- DIS_S: Schools' contribution to the aggregated dissimilarity index (Duncan and Duncan, 1955) [3)]
- SCHOOL AUTONOMY: Index of school autonomy, derived from the numbers of categories that principals classified as being or not being a school responsibility.

Positive values indicate higher levels of school autonomy (OECD 2000b, Technical Report: 245)

- TEACHER AUTONOMY: Index of teacher autonomy, derived from the numbers of categories that principals classified as being mainly the responsibility of teachers. Positive values indicate higher levels of teacher participation in school decisions (OECD 2000b: 245)
- SELECTION BY RESIDENCE: Binary Dummy variable, which takes the value 1 if the school always considers residence in a particular area when students are admitted to the school
- SELECTION BY PERFORMANCE: Binary Dummy variable, which takes the value 1 if the school always considers the student's record of academic performance when students are admitted to the school
- PRIVATE SCHOOL: Binary Dummy variable, which takes the value 1 if the school is managed directly or indirectly by a non-government organisation

c) MEAN OF READING SCORE: Mean of classmates' performance scores in reading. The variable is calculated both as the mean of the reading score of natives and as the mean of the reading score of migrants.

Results are presented in Table 2. Note that we define 'migrants' as students both of whose parents were born abroad. The novelty of our approach lies in its separate modelling of migrant and native achievements and in considering peer effects arising from the influence of both migrant and native mean achievements. Looking at natives first, estimated coefficients are largely as expected from previous research on student PISA achievements. As has been found in the literature, school specific factors turn out to be insignificant when individual factors are controlled for. Among the most significant factors, our results confirm the important role of the parental cultural and socio-economic background. Throughout all groups of countries, 'more than 100 books at home', 'home educational resources' and ISEI contribute to the variance of PISA in a highly significant way. Likewise, in all countries female native students have higher scores than their male compatriots.

Table 2 Explanation of individual PISA reading scores in groups of countries

	Australia, Canada, New Zealand		Denmark, Norway, Sweden		Austria, Germany		Hungary, Czech Republic, Russian Federation	
	Natives	Migrants	Natives	Migrants	Natives	Migrants	Natives	Migrants
Student-specific factors:								
Female	24.36** (1.93)	23.35** (3.40)	26.56** (2.42)	23.46** (8.39)	11.46** (2.72)	10.38 (8.62)	22.02** (2.56)	5.07 (13.80)
Grade 8	-66.79** (6.60)	-49.71** (14.83)	-61.69** (11.68)	-96.78** (18.01)	-69.03** (5.37)	-65.25** (14.18)	-86.91** (9.47)	-131.17** (26.26)
Grade 9	-44.86** (3.35)	-50.69** (7.79)	5.66 (3.38)	13.13 (12.68)	-26.97** (3.09)	-45.24** (11.34)	-30.97** (2.96)	-27.59 (14.85)
Foreign born	-0.74 (7.19)	-14.81** (3.68)	-7.08 (9.84)	7.60 (9.11)	-6.01 (12.85)	-0.66 (8.96)	23.92** (6.93)	7.36 (13.96)
National language at home	37.05** (6.89)	22.65** (3.72)	28.31* (11.19)	33.00** (9.36)	23.55 (17.69)	24.06** (8.48)	-	-
Living with two parents/ guardians	5.77* (2.42)	10.27* (4.73)	12.08** (3.11)	16.62 (10.35)	-1.87 (3.67)	12.25 (14.84)	2.99 (3.19)	-14.23 (14.97)

Table 2 continued

	Australia, Canada, New Zealand		Denmark, Norway, Sweden		Austria, Germany		Hungary, Czech Republic, Russian Federation	
	Natives	Migrants	Natives	Migrants	Natives	Migrants	Natives	Migrants
More than 100 books at home	20.62**	22.34**	31.28**	10.92	18.09**	11.90	18.97**	23.29
	(2.03)	(3.65)	(2.72)	(9.65)	(3.12)	(8.91)	(2.68)	(15.02)
Home educational resources	6.39**	9.37**	8.91**	6.07	4.07**	-1.15	3.39*	4.99
	(1.03)	(2.06)	(1.37)	(5.67)	(1.98)	(4.89)	(1.40)	(7.79)
Homework time	11.27**	8.39**	0.04	0.57	0.59	-3.24	10.72**	7.14
	(1.03)	(1.93)	(1.51)	(4.52)	(1.65)	(4.84)	(1.27)	(5.96)
ISEI	0.78**	0.78**	1.05**	0.68*	0.26**	0.31*	0.49**	0.36
	(0.06)	(0.10)	(0.08)	(0.27)	(0.09)	(0.30)	(0.08)	(0.48)
School-specific factors:								
Student-teaching staff ratio	-	-	0.22	-1.62	-0.52	-1.47	-0.41	-1.82
			(0.48)	(1.83)	(0.35)	(0.94)	(0.27)	(1.69)
Quality of schools' educational resources	-1.99*	-2.32	-1.17	-7.82	0.97	-0.71	-0.99	3.65
	(1.02)	(1.85)	(1.51)	(4.84)	(1.70	(4.56)	(1.13)	(6.64)

Table 2 continued

	Australia, Canada, New Zealand		Denmark, Norway, Sweden		Austria, Germany		Hungary, Czech Republic, Russian Federation	
	Natives	Migrants	Natives	Migrants	Natives	Migrants	Natives	Migrants
Special language courses at school	0.80	0.80	-1.37	-5.98	-1.75	13.57	1.19	18.26
	(2.37)	(4.35)	(4.59)	(14.75)	(3.21)	(10.10)	(2.53)	(15.08)
Village/ small town	-	-	-2.61	-10.34	0.82	-2.37	-2.09	-0.90
			(2.78)	(10.82)	(3.30)	(11.55)	(3.31)	(15.50)
Hours of schooling per year	0.00	-0.01	-	-	-0.02	-0.03	-0.01	-0.02
	(0.00)	(0.01)			(0.01)	(0.04)	(0.01)	(0.07)
DIS	1.88	6.06**	-0.82	-7.45*	-2.97	-6.39	3.00	3.88
	(2.23)	(1.98)	(1.87)	(3.65)	(3.24)	(5.31)	(1.64)	(7.23)
Selection by residence	0.20	-6.11	-0.60	-1.46	-0.03	9.91	1.12	-8.29
	(2.10)	(3.73)	(2.84)	(11.49)	(3.11)	(11.18)	(2.61)	(14.30)
Selection by performance	-	-	-	-	1.58	5.80	-2.17	-7.12
					(3.11)	(9.72)	(2.98)	(21.52)
School autonomy	-3.97**	-1.50	-	-	1.19	-4.42	-0.52	-2.98
	(1.19)	(1.94)			(2.76)	(9.70)	(1.76)	(8.25)

Table 2 continued

	Australia, Canada, New Zealand		Denmark, Norway, Sweden		Austria, Germany		Hungary. Czech Republic Russian Federation	
	Natives	Migrants	Natives	Migrants	Natives	Migrants	Natives	Migrants
Teacher autonomy	0.46	0.88	-	-	-1.13	-3.49	-1.14	2.69
	(0.88)	(1.55)			(1.59)	(4.85)	(1.90)	(9.93)
Private School	-	-	-4.79	21.24	-1.00	4.49	15.74**	48.63
			(5.57)	(19.42)	(6.80)	(30.95)	(5.67)	(34.44)
Mean of reading score: Natives	0.48**	0.30**	0.40**	0.17	0.68**	0.71**	0.71**	0.77**
	(0.03)	(0.04)	(0.04)	(0.11)	(0.04)	(0.12)	(0.04)	(0.20)
Mean of reading score: Migrants	0.04**	0.21**	0.03	0.08	0.09**	0.11	0.03	-0.11
	(0.01)	(0.04)	(0.02)	(0.07)	(0.03)	(0.09)	(0.02)	(0.11)
(adj.) R^2	0.25	0.29	0.20	0.21	0.58	0.59	0.47	0.37
Obs.	17456	4087	5151	486	3635	444	5581	202

Note: Constant included, results not reported. The significance levels indicated by stars refer to the customary levels of 95% (*) and 99% (**). Standard errors in parantheses.

Estimation results for migrants deviate from those of natives in several respects. Leaving aside strong effects arising from the fact that the test was performed by pupils attending lower than 10th grade (representing the omitted reference category for the eighth and ninth grade dummies), the language spoken at home is shown to be the most important factor of educational success (this variable is not available for Hungary, with the result that it could not be considered as an explanatory variable for the group of Central and Eastern Europe). For instance, given all other explanatory factors considered in the equation, the PISA score of children from Scandinavia who do not speak their national language at home is 33.0 points below that of children who do speak the national language at home. Females are still more successful than males, although the difference is significant only for traditional countries of immigration and Scandinavia. As regards the background of parents, only ISEI remains significant in three out of four groups, whereas 'more than 100 books at home' and 'home educational resources' still have positive effects on PISA achievements but become insignificant except for the traditional countries of immigration.

The somewhat surprising insignificance of 'books at home' in the migrant equation (see, for instance, Ammermüller 2005, who finds significant effects for migrants) is the result of dominant and highly significant peer effects which were not considered in previous explanations of PISA scores. [4] Irrespective of whether we consider migrants or natives, the direct influence of the native peer group achievement is larger than the direct influence of the migrant peer group. The peer group impact of natives is particularly high in 'Austria, Germany' as well as in countries of Central and Eastern Europe. The educational systems of both groups are characterised by non-comprehensive schools. The lowest peer group effects can be observed for the comprehensive Scandinavian school system, where only the native-to-native link appears to be significant. The migrant peer group influence becomes important in traditional countries of immigration and in the group 'Austria, Germany'. In both country groups natives, too, are affected by migrant mean achievements, though the stronger impact is on migrants themselves.

In non-comprehensive school systems (see 'Austria, Germany', and 'Central and Eastern Europe'), where students were admitted to schools solely on the basis of previous school performance, a school's average test score is highly correlated with individual test scores. Thus, even after controlling for individual and school characteristics, selection into schools might upwardly bias the coefficient of a school's average score, i.e. the estimated causal impact of peers ('sorting effect'). Our dataset provides a good opportunity to address this issue.[5] The variable 'selection by performance' identifies schools that are most likely to

select students on the basis of previous schooling performance measures. For this reason, we have run the same regressions omitting schools which are identified by this dummy variable. This procedure has been carried out for 'Austria, Germany' as well as for the group 'Hungary, Czech Republic and Russia'. As the variable in question was not available for the other two country groups, for these countries we instead proceed by using a sub-sample of schools in which schools which select students 'by residence' were omitted.

Table 3 provides information about peer effects estimated for full samples (see Table 2) and after omitting students who are identified as being 'selected'. Parameters apply to the equation of 'natives'.[6] As can be seen from the results, parameter estimates are pretty stable given the reduced number of observations in the sub-sample (for instance, the native-to-native effect in 'Austria, Germany' falls slightly from 0.68 to 0.57, whereas for the same group the migrant-to-native effect increases from 0.09 to 0.12). These results support inferences drawn with respect to peer effects and social multipliers.

Table 3 Sensitivity analysis; change of peer effects after omitting schools which select students by performance a) or residence b)

	Australia, Canada, New Zealand	Denmark, Norway, Sweden	Austria, Germany	Hungary, Czech Republic, Russia
Mean of reading score: Natives	0.48** → 0.46**	0.40** → 0.45**	0.68** → 0.57**	0.71** → 0.65**
Mean of reading score: Migrants	0.04** → 0.05	0.03 → 0.01	0.09** → 0.12**	0.03 → 0.07
Number of observations	17,456 → 3599	5151 → 1188	3635 → 1089	5581 → 1403

Note: See the test for details; a) 'Austria, Germany', 'Hungary, Czech Rep., Russia', b) 'Australia, Canada, New Zealand', 'Denmark, Norway, Sweden'; parameter estimates refer to the equation of 'natives'; **) refers to significance at the 1% level.

How do estimates from Table 2 translate into social multipliers? In the following, we simplify model equations (4) by assuming that changes of exogenous migrant-specific

variables are identical to changes of exogenous for native-specific variables, i.e. $\Delta\overline{X}^n = \Delta\overline{X}^m$.

We do not consider school-specific changes, i.e. $\Delta R = 0$, such that equation (4) boils down to

$$\Delta\overline{P}^m = M^m\left(\beta_m^{'} + \gamma_n^m M^n \beta_n^{'}\right)\Delta\overline{X} \tag{6}$$

In Table 4, we provide numerical values of social multipliers presented in (5) and total (primary and secondary) aggregate effects derived according to (6). Throughout all countries the size of the multiplier effect on natives is higher than the impact on migrants. Further inspection reveals that in the Austria-Germany group (4.0), as well as in Central and Eastern Europe (3.5), multipliers are higher than elsewhere. The smallest effect was found for the Scandinavian group (1.7). Multipliers for migrants are almost non-existent (i.e. not different from the value one) for Denmark, Norway, Sweden and the Czech Republic, Hungary, Russia, and once again highest for Austria, Germany (1.5).

Table 4 Calculation of social multipliers

	Social multiplier effects	
	M^m (migrants)	M^n (natives)
Australia, Canada, New Zealand	1.30	1.98
Denmark, Norway, Sweden	1.10	1.68
Austria, Germany	1.45	4.03
Czech Republic, Hungary, Russia	1.00[1]	3.45[1]

Note: [1)] Insignificant parameter estimates from Table 2 are restricted to zero.

Results in Table 2 represent direct immediate-impact influences of explanatory factors at the individual student level. Table 2 does not provide information about aggregate ('long-term') multiplier effects that arise when the influence of, say, native student i propagates to migrant student j and native student k, and from there to other pupils and finally back to student i. This total multiplier effect on aggregate PISA reading achievements is captured by $M^m\left(\beta_m^{'} + \gamma_n^m M^n \beta_n^{'}\right)$ in (6). Employing direct and indirect components, we calculate total multipliers for the important cultural and socio-economic background factors 'language spoken at home' and 'books at home'. Results are presented in Table 5, where immediate impacts from Table 2 are provided in parentheses.

Table 5 Total aggregate social multiplier effects

	Foreign Language spoken at home		More than 100 books at home	
	migrants	natives	migrants	natives
Australia, Canada, New Zealand	-58.24 (-22.62)	-75.73 (-37.05)	45.10 (22.34)	43.16 (20.62)
Denmark, Norway, Sweden	-45.09 (-33.00)	-49.45 (-28.31)	21.79 (10.92)	53.22 (31.28)
Austria, Germany	-132.44 (-24.06)	-107.52 (-23.55)	92.20 (11.90)	79.13 (18.09)
Czech Republic, Hungary, Russia	-	-	73.66 (23.29)	65.41 (18.97)

Note: Immediate impact (individual level estimates) in parentheses

Evidently, considering multiplier effects boosts the gap between countries with comprehensive and non-comprehensive school systems. Whereas the disadvantage of cultural and language deficits at home seemed to be relatively small and more or less the same for all immediate-impact estimates and all countries (see Table 2), peer effects and social interaction magnifies individual shortcomings arising from the family background. This conclusion holds for both native and migrant students. Total aggregate effects for both types of students are close to each other. Whereas, for instance, the overall disadvantage of not speaking the national language at home is about -132.4/ -107.5 in Austria and Germany, it is 'only' -45.1/ -49.5 in the Scandinavian group of countries. The gap between the Scandinavian countries and Austria/ Germany can be measured by comparing the ratio of total to direct impacts. Again focusing on the disadvantage from not speaking the national language at home, where immediate impact multipliers are estimated as -24.1/ -23.6 (migrants/natives in Austria, Germany) and -33.0 / -28.3 (Scandinavia), ratios turn out to be much higher for the Austria-Germany group (5.5 /4.6) than for the Scandinavian group (1.4/ 1.8). Thus, aggregation reveals that social interaction within and between groups magnifies direct disadvantages existing at the individual level in general (all multipliers are above unity), but the aggregate disadvantage is much stronger and aggravated in Austria/ Germany. These results confirm the

hypothesis that non-comprehensive school systems magnify the prevailing educational inequality between students with a low parental socioeconomic migration background and children from more privileged families.

Conclusions

This article analysed the school performance of migrants dependent on different schooling systems and immigration policy regimes. The novelty of our approach lies in considering peer effects for both natives and migrants and aggregating individual peer group effects to social multipliers. Taking all multiplier effects of social interaction into account, we confirm the hypothesis that non-comprehensive school systems magnify the prevailing educational inequality between students with a low parental socio-economic migration background and children from more privileged families. This conclusion is based on the international data set of the OECD PISA test.

Looking for reasons and examining interactions between groups by disentangling total multipliers into direct and indirect effects, results show that both native-to-native and migrant-to-migrant peer effects are much higher in ability differentiated school systems (represented by a group consisting of Austria and Germany in our data set) than corresponding effects in comprehensive Scandinavian schools. The overall effect of schooling systems thus seems to depend on the social interaction between high and low ability students and resulting peer effects.

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Notes

1. In Austria and Germany, there are 4 school types available to 15-year-olds, whereas in Denmark, Sweden and Norway only one comprehensive school exists. The first age of selection in the education system is 10 in Austria and Germany, whereas it is 16 in all Scandinavian countries (OECD 2004, p. 262, Figure 5.20a).
2. The same source (OECD 2004) does not contain corresponding information on the Russian education system.
3. $DIS_s = \left(M_s / M_{country} - N_s / N_{country} \right) * 100$, where M = number of migrants in respective school or country, and N = number of natives in respective school or country (see also Schnepf 2004).

4. Non-reported sensitivity analysis shows that for all country groups 'books at home' reappears as a significant factor of migrants' PISA scores when we omit the peer effect measures from the equations.
5. We are grateful to Peter Mueser for pointing out this testing strategy to us.
6. As the creation of subsamples causes a loss of many observations, we were not able to replicate the robustness check for the equation of migrants.

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