Does (Private) Education Matter? Recent evidence from international OECD data

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Abstract: What follows is an exercise aimed at estimating private vs. public school effect on academic achievement. It is based on the analysis of Math, Science and Reading test scores of 15 year-olds students surveyed in 2002 across OECD and non-OECD countries. Its main purpose is to get an accurate measure of the achievement differentials of students that have chosen to attend private and public schools. To do so, it is absolutely necessary to control for all exogenous factors that influence outcome and have nothing to do with a private/public effectiveness differential. We henceforth control for different types of bias: the student and the student's peer group (observed) socio-economic background, but also variables that are not observed by the statistician (like motivation). The latter is done using an endogenous treatment model derived from Heckman's two-stages approach of endogeneity/selectivity. Estimations show that the effect of a private education varies across countries: in a first group of country, students from private schools perform better. In a second group, there is no distinct effect of a public/private education. Finally, in a third, smaller group, public schools seem to outperform private ones.

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Introduction

It is clear that the production of education requires monetary resources. Yet, several studies (e.g. Hanushek, 1986; Hanushek, 2000) have repeatedly highlighted over the last two decades the fact that there is no mechanical relationship between the level of public spending and pupils' results. In this context, economists and other social scientists have come to consider that more attention should be paid to the organizational characteristics of schools, in particular whether it makes a difference that they are privately run or directly governed by central or local public authority. Is there some (robust) evidence that students could gain/loose by transferring from a public to a private school? And if so, what is the magnitude of the differential?

The study of existing education systems can provide part of the answer to this question. Indeed, in many countries around the world, although education is funded by public money, its production is far from being a public monopoly. In the Netherlands, and to a lesser extend in Belgium, Ireland, Spain or Denmark, significant portions of the student/pupil population attend schools operated by non-profit private boards. There is indeed an old tradition of education entrepreneurship within the non-profit sector. The Catholic and Protestant churches for example have been very active in establishing schools that are now largely funded by public money.

It is thus not a real surprise that both private and public schools are represented in the latest OCDE survey on academic achievement. We are here referring to the Program for International Student Assessment (PISA). This survey, carried out in 2000, is aimed at testing the competencies in Math, Sciences and Reading of representative samples of 15 year-olds students across OCDE and non-OECD countries[1]. The resulting data set is very rich and can be used to address many questions relevant to education policy, one of them being the presence and the magnitude of a private/public achievement differential.

To avoid any confusion, the reader should take good note of the way private/public categories are defined by the OECD. A public school is a school managed directly or indirectly by a public education authority, government agency, or governing board appointed by government or elected by public franchise. While a private school is a school managed directly or indirectly by a non-government organization (e.g., a church, trade union, businesses, other private institutions.). In brief, the underlying criteria is not that of the origin of financial resources but the legal status of the school board.

This paper is organized in 3 sections. Section 1 briefly exposes our theoretical framework i.e. the education production function we attempt to estimate, as well as the different categories of variables and biases that must be accounted for in order to isolate a true private/public effectiveness differential. It also contains the empirical strategy used to estimate these models. Section 2 presents the international data set we use, while Section 3 contains the results of our empirical analysis that we confront to those of previous studies.

1. Education Production Function with Private/Public school effect: presentation and generic problems

Following Summers & Wolfe (1977) and Toma & Zimmer (2000), we use test scores as a measure of output. We assume that academic achievement, at any time period t, is a function of family and school

[1] Australia, Austria, Belgium (French-Speaking), Belgium (Dutch-Speaking), Brazil, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Hong Kong China, Korea, Latvia, Luxembourg, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Spain, Sweden, Switzerland, United Kingdom, United States.

resources, of the student's peers[2], and of the student's individual characteristics. Conceptually, the model to be estimated at any time period t is:

$$A = f(R, SC, P) \quad (1)$$

Where A = student's achievement, R = vector of school monetary resources or proxies, SC = vector of student's characteristics, including family/social background; P = some characterization of the group of peers (e.g. mean SC of classmates).

Following McEwan (2001) and Greene (2000), we hypothesize that student *i*'s achievement (A_{ij}) in country *j* can be explained by linear models of the following form:

i= student index
j= country index

$$A_{ij}=R_{ij}\alpha_j + SC_{ij}\beta_j + P_{ij}\chi_j + \delta_j PRIV_{ij} + \varepsilon_{ij} \quad (2)$$

where $PRIV_{ij}$ is a dummy variable indicating whether or not the *i*th students attended private school.

If the independent variables (R_{ij}, SC_{ij}, P_{ij}) perfectly control for the student background, then estimating the preceding equation with Ordinary Least Squares (OLS) yields unbiased estimates. The estimated value for coefficient δ will capture the effectiveness differential between private and public schools.

But it is extremely likely that some background variable are imperfectly measured or omitted from regressions. For example, more able or motivated students could select themselves into private schools. Or, equivalently, private schools may select such students from the waiting list if admissions are over-subscribed. Because selection or self-selection are unobserved, the relative effectiveness of private and public schools could be confounded with the background of their students.

In order to eliminate this selection bias, we use the so-called "treatment effect" model (a variant of the two-steps correction model suggested initially by Heckman, 1979). This method presumes that a choice is made between two alternatives: private or public.

Consider the following (first step= choice) model within each j country. The binary variable PRIV is assumed to stem from an unobserved latent variable

$$PRIV^{*}_{ij}=Z_{ij}\zeta_j + \mu_{ij} \quad (3)$$

The choice to attend or not a private school is made according to the rule

$$PRIV=1 \text{ if } PRIV^{*}_{ij}>0, \; PRIV=0 \text{ otherwise} \quad (4)$$

Let us now consider the outcome (second step = achievement) model. The basic idea of Heckman is to account for the fact that achievement in private school ($A_{ij} \mid PRIV_{ij}=1$) is only observed when the value of the latent variable of the choice model is positive ($PRIV^*>0$). Algebraically, this means that

[2] We indeed assume child's ability to acquire formal knowledge is influenced by the characteristics of his/her peers. Formal education inevitably takes place in classrooms where students are together and interact. In turn, these classrooms are part of a school where students tend also to interact, generating what pedagogues call peer effects (Slavin, 1987 ; Grisay, 1993 ; Gamoran & Nystrand, 1994), sociologists contextual effects (Coleman, 1966, 1988; Jencks & Meyer, 1987; Willms & Echols, 1992) and economists social externalities (Henderson, Mieskowski & Sauvageau, 1978 ; Hanushek, 1986 ; Brueckner & Lee, 1989 ; Bénabou, 1993, 1996 ; Glewwe, 1997; Vandenberghe, 2002).

$$E(A_{ij} \mid PRIV_{ij}=1) = E(A_{ij} \mid PRIV^*_{ij}>0)$$
$$= E(A_{ij} \mid \mu_{ij} >- Z_{ij}\zeta_j)$$
$$= R_{jj}\alpha_j + SC_{ij}\beta_j + P_{jj}\chi_j + \delta_j + E(\varepsilon_{ij} \mid \mu_{ij} >- Z_{ij}\zeta_j)$$
$$= R_{jj}\alpha_j + SC_{ij}\beta_j + P_{jj}\chi_j + \delta_j + \rho\sigma_\varepsilon [\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)] \quad (5)$$
$$\text{if } (\mu_{ij}, \varepsilon_{ij}) \sim \text{bivariate normal } [0,0,1, \sigma_\varepsilon, \rho]$$

where ϕ is the probability density function, and Φ the cumulative distribution function of the standard normal distribution, ρ being the correlation coefficient between μ_{ij} and $\varepsilon_{ij.}$

Equivalently for the expected achievement of students who choose public school is

$$E(A_{ij} \mid PRIV_{ij}=0) = R_{jj}\alpha_j + SC_{ij}\beta_j + P_{jj}\chi_j + \rho\sigma_\varepsilon [\phi\ (Z_{ij}\zeta_j)/1-\Phi(Z_{ij}\zeta_j)] \quad (6)$$

Finally, it is worth observing that difference between the two types of schools in country *j* is

$$E(A_{ij} \mid PRIV_{ij}=1) - E(A_{ij} \mid PRIV_{ij}=0) = \delta_j + \rho\sigma_\varepsilon [\phi\ (Z_{ij}\zeta_j)/1-\Phi(Z_{ij}\zeta_j)] \quad (7)$$

Equation (7) shows that if the selectivity correction term is omitted from the achievement equation, then this difference is what is estimated by the least square coefficient of the treatment dummy variable. As by assumption all terms of the last part of Equation (7) are positive, we see that OLS overestimate the treatment effect (Greene, 2000).

The adequate estimation strategy is thus to first estimate the choice model (Equations 3 and 4) using a Probit (i.e Normal) specification linking linear expression $Z_{ij}\zeta_j$ to the probability of attending a private school. The results can be used to compute $[\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)]$ for each individual *i* in country *j*. These terms are then introduced into the achievement equation (5) on the same foot as the other variables.

$$A_{ij}=R_{jj}\alpha_j + SC_{ij}\beta_j + P_{jj}\chi_j + \delta_j PRIV_{ij} + PRIV_{ij}.\rho\sigma_\varepsilon [\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)] + (1-PRIV_{ij}).[\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)] + \eta_{ij} \quad (8)$$

OLS estimate for private school treatment (δ_j) in this "augmented" equation should then be unbiased.

Finally, following Vella (1998), we should not be too concerned about "identification" problems when Z=X (i.e. when the list of variables used to explain private school attendance – here R_{ij}, SC_{ij} and P_{ij} – is the same as the set of determinants of achievement). This is because the expression $PRIV_{ij}.\rho\sigma_\varepsilon [\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)] + (1-PRIV_{ij})^* [\phi\ (Z_{ij}\zeta_j)/\ \Phi(Z_{ij}\zeta_j)]$ is a non-linear expression of $Z_{ij}\zeta_j$ (and thus of $X_{ij}\zeta_j$ if the set of explanatory variables are identical).

2. Data set and estimation strategy

Data and variable categories

The data we use to assess the impact of school, socio-economic, and peer effects is relatively unique and fairly recent. It comes from the 2000 OECD survey (the so-called PISA project, Program for International Student Assessment). This database contains math, science and reading test scores of students aged 15 across 34 OECD and non-OECD countries. These students are nested in within schools, potentially attending different grades in countries with grade repetition. The test score variable has been normalized[3] to have mean 1 and variance 0. To carry out our analysis, we only selected countries for which the number of students sampled and attending private school is above a

[3]Normalisation to mean ***M*** and standard deviation ***S***, simply transforming x to y with formula y= ***S****(x-E(x))/Sx + ***M***

10% threshold. This lead to a subset of countries containing the Netherlands, Belgium, Mexico, Ireland, Spain, France, Denmark, Austria and Brazil. Justifications for this restriction are twofold. First, it makes no sense, statistically speaking, to assess a private school effect in a particular country using test scores of just of few dozen students. Second, policy makers who currently discuss the opportunity to expand the private sector (using vouchers for example) are interested in knowing whether private schools make a difference when attended by a large (and heterogeneous) population. This justify focusing on countries for which the (sample) share of private education is quite large[4], as in Belgium or the Netherlands where more than 50% of secondary school students attend a private school.

Table 1 below gives the students' repartition between public and private schools, by country, for each one of the PISA samples we used (Mathematics, Reading and Sciences).

[Insert Table 1 about here]

Referring to equation (1) in section 1, we have information about school inputs [R in equation 1]. Student/teacher ratio (STRATIO) and school total enrollment (SCHSIZE) are available. These two variables combined form a good proxy for per-student expenditure. Student/teacher ratio directly affect cost per student, while school total enrollment could also be interpreted as a proxy for per-student spending: the higher SCHSIZE the lower should be per-student spending as economies of scale generally play a decisive role in secondary education cost functions. The data set also contains self-reported information regarding the state of the buildings and the availability of teaching material. We use answers provided by heads of school to build dummy variables identifying schools with poor buildings (PRBUILD) and lack of teaching material (LCTMAT)

The data set (see table 2 for descriptive statistics) is relatively rich in terms of individual characteristics and family socio-economic background/status [SC, in equation 1] information that are known to affect academic achievement. This includes, besides gender (GIRL), the number of siblings (NSIB), the birth order of the student (BRTHORD), highest degree of mother (MISCED) of father (FISCED), immigration status of father (FATHIM), the highest socio-economic index of the two parents (HISEI) [5] as well as an index of his/her cultural resources (HEDRES) [6].

[Insert Table 2 about here]

Of great interest is the peer effect [P, in equation 1]. We define it as *the average* parental socio-economic index (HISEI) of the student' schoolmates (PHISEI), assuming that the peer effect is better captured by the socio-economic mix of the peer group.

Finally, private schools are identified by a dummy variable (PRIV) equals to 1 by contrast to the public schools for which the dummy equals 0.

Estimation strategy

We logically focus on the magnitude of the private/public school differential. Using scores that have been standardized by country (i.e. for each country mean score=0 and standard deviation=1), we first measure gross differentials. We do so simply by comparing the mean values of math, science and reading test scores of students for each type of school (the gross differential being equal to private

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[4] Assuming that the PISA sample is representative of the private/public division in reality.

[5] The last variable is the result of the conversion of Isco-88 (International Standard Classification of Occupations) into International Socio-economic Index of Occupational Status (ISEI). For further details see http://www.fss.uu.nl/soc/hg/pisa/index.htm

[6] The last variable is built by the authors following using several items available in the surveys. Technically speaking it constists of the estimate of an implicit variable using an Item Response Model and a Maximum Likelyhood algorithm.

mean minus public mean). Using the different independent variables potentially explaining pupils' results we then run the traditional OLS models to get a first estimate of the net private school effect i.e. controlling for level of resources, socio-economic status and peer endowments. The last step is to estimate a real "treatment effect" model using the two-steps method exposed in section 1. Contrary to the OLS approach, this should produce unbiased estimates of private school effects.

The choice equation regresses the set of individual characteristics (Z=GIRL, NSIB, BRTHORD, MISCED,FATHIM, HISEI, HEDRES) on the private/publid dummy (PRIV). While the achievment equation regresses the whole set of variable (X=Z+STRATIO, SCHSIZE, PRBUILD, LCTMAT, PHISEI) on acheivement (A).Note that the two equations contain the same set of individual variables Z. To avoid identification problems (i.e. collinearity between mill's ratio ϕ $(Z_{ij}\zeta_j)$/ Φ $(Z_{ij}\zeta_j$) and X (containing Z)), we add to the selection equation a variable that operates like an instrument: the percentage of a school total resources that are of public origin (PERCPUBL).

3. Results and analysis

In Tables 5-7 below, we present three results of interest: [1] the gross score differential between private and public students, [2] the coefficient associated to the PRIV dummy (δ) in an OLS regression model without control for selection biases and [3] the coefficient associated to the PRIV dummy (δ) in the treatment model. Since the dependent variable (score) has been normalized, this last coefficient can be interpreted as the proportion of the standard deviation explained by the public/private effect.

A first – general – result is that selection biases are identified in a few cases only. The vast majority of regressions show no significant correlation between the error terms of equations (2) and (3). Hence, in all those cases, estimates of private school effects provided by OLS can be considered as unbiased. For the convience of the exposure, we systematically report in the second column of table 5 to 7, the 'best' estimate of private school effect. This simple means that we retain the OLS estimate when the treatment effect models suggest the absence of selection bias (i.e. no correlation between error terms $\equiv \rho$ not statistically different from 0) and, of course, the treatment effect estimate otherwise.

Math test scores (Table 5) are higher in private schools in countries like Brazil (+48% of a standard deviation), the Dutch-speaking community of Belgium (+16% of a standard deviation), Ireland (+13%) and to a lesser extent in France (+7%). But in all other countries examined, the private school effect is not statistically significant.

Private training may also matter when it comes to reading literacy (Table 6). It has a positive effect in the case of Brazil (+47%) and Belgium (both Dutch (+24%) and French-Speaking (+29%)). But it is worth emphasizing that private management is also associated with lower achievement in the case of Austria (-19%) and, to a larger extent, Netherlands (-68%).

Results for science (Table 7) reveal a similar pattern. Private school still has a positive effect on achievemnet in the case of Brazil (+53%) the French-Speaking Community of Belgium (+19,8%)). But, as in the case of science, private management is synonymous with lower achievement in the Netherlands (-92%).

[Insert Tables 5-7 about here]

Table 8 containts a summary of the results by country and topic. It clearly sugggests the absence of systematic advantage to private schools if we look at average results by topic. On average, for Math, the estimate of the private school dummy is zero. The same conclusion holds for reading literacy and sciences. Yet, if one take a country perspective, the conclusion is sligthly different. For countries like Brazil, Ireland and Belgium (both Dutch and French-Speaking) private school management rather systematically goes with better achievement *ceteris paribus*. In a second group of countries(Spain, France, Mexico and Denmark), private and public schools achieve equally, on average, across the three disciplines. Then come countries like Austria and the Netherlands where public school seem to outperform private schools once other determinants of achievment are controlled for.

[Insert Table 8 about here]

Conclusion

Our results indicate that, even when selection biases are taken into account, the type of school (private of prublic) attended can have a significant effect on 15 year-olds' academic achievement. This was shown using math, reading literacy and science test scores. We conclude to the absence of systematic advantage to private schools. On average, for Math, the estimate of the private school dummy is zero. The same conclusion holds for reading literacy and sciences.

Yet the conclusion is sligthly different if one looks at our results from a country perspective. In Brazil, Ireland and Belgium (both Dutch and French-Speaking) private school management generally goes with better achievement. Private and public schools tend to achieve equally in Spain, France, Mexico and Denmark. But in the case of Austria and the Netherlands public schools seem to outperform private ones. This results provide some answer to our initial interrogation, but raise additional questions.

How come that the advantage to private schools holds only for some countries ? Conversely, how can one explains that in some other countries privately run schools seem to deliver less than public ones? Two alternative, sometimes conflicting, interpretations coexist to explain private vs. public effet. The first interpretation, which would be favored by economists, is that the private and public dichotomy in fact reveals differences in regulation. This is the “organizational” interpretation of achievement difference. Following this line of reasoning, private school in Brazil, Ireland or Belgium could possibly perform better because they are granted more autonomy. And maybe – although that seems harder to believe up front – private schools have less autonomy that public ones in the Netherlands or Austria.

However, McEwan (2000) points out a more “cultural” interpretation of private/public school difference. Rather than talking about “private schools” effects, it might make more sense – at least in some countries like Ireland or Belgium -- to talk about “religious” schools effect. Indeed, a majority of private schools are, *in fine*, run by religiously affiliated boards (the author focuses on the example of Catholic Schools). According to this cultural interpretation, the (marginally) better training received in private schools could be explained by religious values. In fact, the main religions existing today enhance values such as hard work, effort and dedication to a task.

Further research is needed to explore these two categories of assumption. But this means that we need more detailed data about regulatory environemnet and management style of both public and private schools in countries in which these two types of school cohabit. And as regards private school, following Mc Ewan's remarks, we would also need to distinguishing private schools that are religiousy affiliated, those that are secular or simply profit-making.

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Table 1 - Number of students, breakdown by country and type of school (0=public, 1=private).

country	Math		Read		Sciences	
	N_private	N_public	N_private	N_public	N_private	N_public
BRAZIL	391	2319	591	4154	390	2313
MEXICO	374	2174	1901	834	374	2156
BEL_NL	1681	530	2996	894	1666	514
BEL_FR	1074	474	693	4187	1338	778
SPAIN	1349	2079	943	3106	1070	448
NETHERLANDS	989	332	2417	1405	1372	2085
IRELAND	1340	770	677	3889	1010	327
AUSTRIA	330	2310	902	3303	332	2337
FRANCE	501	1841	1798	595	502	1832
DENMARK	532	1744	2453	3761	522	1726
	%_private	%_public	%_private	%_public	%_private	%_public
BRAZIL	14,43%	85,57%	12,46%	87,54%	14,43%	85,57%
MEXICO	14,68%	85,32%	69,51%	30,49%	14,78%	85,22%
BEL_NL	76,03%	23,97%	77,02%	22,98%	76,42%	23,58%
BEL_FR	69,38%	30,62%	14,20%	85,80%	63,23%	36,77%
SPAIN	39,35%	60,65%	23,29%	76,71%	70,49%	29,51%
NETHERLANDS	74,87%	25,13%	63,24%	36,76%	39,69%	60,31%
IRELAND	63,51%	36,49%	14,83%	85,17%	75,54%	24,46%
AUSTRIA	12,50%	87,50%	21,45%	78,55%	12,44%	87,56%
FRANCE	21,39%	78,61%	75,14%	24,86%	21,51%	78,49%
DENMARK	23,37%	76,63%	39,48%	60,52%	23,22%	76,78%

Source: PISA (2000)

Table 2 – Descriptive statistics: Math (Freq, Mean, *Standard Deviation*)

Country	N	A	girl	stratio	prbuild	lctmat	schlsize	nsib	brthord	misced	fathim	hisei	hiseisq	hedres
AUSTRIA	2640	0,00	0,49	12,48	0,20	0,09	579,54	1,60	1,72	4,05	0,12	49,02	2599,16	0,26
		1,00	*0,50*	*7,95*	*0,40*	*0,29*	*458,53*	*1,16*	*1,06*	*1,15*	*0,33*	*14,03*	*1495,48*	*0,79*
BEL_FR	1548	0,00	0,50	10,50	0,19	0,22	648,11	1,99	1,84	4,59	0,27	50,83	2877,50	0,08
		1,00	*0,50*	*4,84*	*0,39*	*0,42*	*291,90*	*1,47*	*0,98*	*1,58*	*0,44*	*17,14*	*1816,78*	*1,00*
BEL_NL	2211	0,00	0,48	9,38	0,08	0,02	694,30	1,65	1,74	4,67	0,10	48,33	2601,01	0,25
		1,00	*0,50*	*3,37*	*0,27*	*0,15*	*360,39*	*1,25*	*1,05*	*1,23*	*0,30*	*16,29*	*1652,89*	*0,86*
BRAZIL	2710	0,00	0,52	30,98	0,16	0,20	1293,99	2,45	1,82	3,24	0,01	42,77	2126,46	-1,44
		1,00	*0,50*	*11,97*	*0,36*	*0,40*	*1083,75*	*1,60*	*0,91*	*1,59*	*0,11*	*17,23*	*1658,36*	*1,33*
DENMARK	2276	0,00	0,49	11,63	0,18	0,12	421,78	1,88	1,91	4,83	0,09	49,98	2749,59	-0,21
		1,00	*0,50*	*2,67*	*0,38*	*0,33*	*206,17*	*1,24*	*0,97*	*1,28*	*0,29*	*15,87*	*1659,61*	*0,95*
FRANCE	2342	0,00	0,51	12,56	0,10	0,07	892,82	1,86	1,84	4,34	0,19	48,26	2619,01	0,15
		1,00	*0,50*	*2,96*	*0,30*	*0,25*	*524,47*	*1,29*	*0,98*	*1,43*	*0,39*	*17,03*	*1755,45*	*0,90*
IRELAND	2110	0,00	0,52	15,04	0,20	0,12	563,94	2,57	1,87	4,31	0,06	48,21	2556,34	-0,16
		1,00	*0,50*	*1,77*	*0,40*	*0,33*	*230,98*	*1,41*	*0,87*	*1,51*	*0,23*	*15,23*	*1529,50*	*1,05*
MEXICO	2548	0,00	0,49	27,39	0,30	0,34	908,84	2,93	1,95	2,97	0,04	43,20	2157,83	-0,68
		1,00	*0,50*	*10,72*	*0,46*	*0,47*	*1110,06*	*1,69*	*0,81*	*1,60*	*0,19*	*17,09*	*1695,87*	*1,28*
NETHERLANDS	1321	0,00	0,50	15,61	0,21	0,11	944,34	1,91	1,95	3,98	0,13	51,69	2935,48	0,35
		1,00	*0,50*	*5,07*	*0,41*	*0,31*	*502,75*	*1,18*	*0,95*	*1,43*	*0,34*	*16,23*	*1689,23*	*0,75*
SPAIN	3428	0,00	0,51	14,47	0,19	0,14	760,50	1,48	1,66	3,41	0,03	45,02	2295,90	0,19
		1,00	*0,50*	*4,72*	*0,39*	*0,34*	*377,22*	*1,05*	*1,04*	*1,63*	*0,18*	*16,40*	*1682,35*	*0,83*

Source: PISA (2000)

Table 3 – Descriptive statistics: Reading (Freq, Mean, *Standard Deviation*)

Country	N	A	girl	stratio	prbuild	lctmat	schlsize	nsib	brthord	misced	fathim	hisei	hiseisq	hedres
AUSTRIA	4745	0,00	0,49	12,51	0,20	0,10	579,32	1,61	1,73	4,04	0,12	48,95	2591,27	0,25
		1,00	*0,50*	*7,93*	*0,40*	*0,29*	*459,74*	*1,17*	*1,06*	*1,12*	*0,33*	*13,99*	*1483,78*	*0,80*
BEL_FR	2735	0,00	0,51	10,59	0,19	0,22	653,19	1,97	1,82	4,59	0,27	50,68	2854,06	0,11
		1,00	*0,50*	*4,84*	*0,39*	*0,42*	*287,86*	*1,46*	*0,99*	*1,57*	*0,44*	*16,89*	*1788,07*	*0,96*
BEL_NL	3890	0,00	0,48	9,51	0,08	0,02	704,27	1,64	1,76	4,70	0,10	48,73	2640,93	0,30
		1,00	*0,50*	*3,32*	*0,27*	*0,15*	*358,80*	*1,23*	*1,05*	*1,20*	*0,30*	*16,33*	*1672,27*	*0,80*
BRAZIL	4880	0,00	0,52	30,93	0,16	0,20	1293,99	2,44	1,83	3,22	0,01	42,80	2126,85	-1,45
		1,00	*0,50*	*11,92*	*0,37*	*0,40*	*1077,39*	*1,59*	*0,91*	*1,59*	*0,11*	*17,19*	*1648,71*	*1,34*
DENMARK	4049	0,00	0,49	11,65	0,18	0,12	423,09	1,91	1,89	4,83	0,10	49,88	2744,84	-0,21
		1,00	*0,50*	*2,63*	*0,38*	*0,33*	*205,92*	*1,28*	*0,96*	*1,28*	*0,29*	*16,01*	*1667,23*	*0,93*
FRANCE	4205	0,00	0,50	12,55	0,10	0,06	892,09	1,84	1,84	4,35	0,19	48,12	2602,60	0,16
		1,00	*0,50*	*2,96*	*0,30*	*0,25*	*521,35*	*1,28*	*0,99*	*1,43*	*0,39*	*16,94*	*1743,32*	*0,88*
IRELAND	3822	0,00	0,52	15,01	0,20	0,12	562,95	2,59	1,85	4,29	0,06	48,56	2601,86	-0,14
		1,00	*0,50*	*1,77*	*0,40*	*0,33*	*230,18*	*1,42*	*0,87*	*1,51*	*0,24*	*15,62*	*1582,23*	*1,03*
MEXICO	4566	0,00	0,49	27,32	0,30	0,34	902,18	2,94	1,95	2,93	0,04	43,07	2152,36	-0,68
		1,00	*0,50*	*10,73*	*0,46*	*0,47*	*1090,25*	*1,68*	*0,82*	*1,58*	*0,20*	*17,25*	*1714,49*	*1,28*
NETHERLANDS	2393	0,00	0,50	15,71	0,21	0,10	950,57	1,89	1,96	4,01	0,13	51,77	2939,60	0,36
		1,00	*0,50*	*4,99*	*0,41*	*0,30*	*497,40*	*1,18*	*0,95*	*1,45*	*0,33*	*16,10*	*1667,06*	*0,73*
SPAIN	6214	0,00	0,50	14,45	0,19	0,13	760,33	1,50	1,66	3,40	0,03	45,05	2297,51	0,20
		1,00	*0,50*	*4,71*	*0,39*	*0,34*	*377,43*	*1,07*	*1,04*	*1,64*	*0,18*	*16,38*	*1680,76*	*0,84*

Source: PISA (2000)

Table 4 – Descriptive statistics: Science (Freq, Mean, *Standard Deviation*)

Country	N	A	girl	stratio	prbuild	lctmat	schlsize	nsib	brthord	misced	fathim	hisei	hiseisq	hedres
AUSTRIA	2669	0,00	0,50	12,46	0,21	0,10	579,38	1,61	1,74	4,04	0,13	48,86	2577,05	0,23
		1,00	*0,50*	*7,92*	*0,40*	*0,30*	*461,72*	*1,17*	*1,06*	*1,10*	*0,34*	*13,79*	*1462,53*	*0,81*
BEL_FR	1518	0,00	0,50	10,49	0,18	0,22	649,71	1,99	1,86	4,62	0,28	50,34	2818,32	0,10
		1,00	*0,50*	*4,77*	*0,39*	*0,41*	*288,78*	*1,46*	*0,99*	*1,54*	*0,45*	*16,87*	*1777,77*	*0,95*
BEL_NL	2180	0,00	0,47	9,41	0,08	0,02	696,50	1,64	1,77	4,70	0,11	48,64	2634,77	0,28
		1,00	*0,50*	*3,39*	*0,27*	*0,15*	*361,47*	*1,21*	*1,05*	*1,19*	*0,31*	*16,42*	*1673,89*	*0,82*
BRAZIL	2703	0,00	0,52	31,04	0,16	0,20	1299,72	2,44	1,82	3,23	0,01	42,96	2148,43	-1,45
		1,00	*0,50*	*11,92*	*0,37*	*0,40*	*1078,87*	*1,60*	*0,91*	*1,62*	*0,10*	*17,41*	*1676,21*	*1,33*
DENMARK	2248	0,00	0,50	11,65	0,18	0,12	421,93	1,93	1,90	4,83	0,09	49,66	2726,35	-0,20
		1,00	*0,50*	*2,63*	*0,38*	*0,33*	*206,04*	*1,31*	*0,96*	*1,28*	*0,29*	*16,14*	*1681,18*	*0,91*
FRANCE	2334	0,00	0,50	12,55	0,10	0,06	891,45	1,82	1,84	4,38	0,18	48,46	2640,15	0,16
		1,00	*0,50*	*2,94*	*0,30*	*0,24*	*521,62*	*1,25*	*0,99*	*1,44*	*0,39*	*17,08*	*1775,49*	*0,88*
IRELAND	2116	0,00	0,52	14,99	0,20	0,12	561,06	2,57	1,87	4,28	0,06	48,56	2604,31	-0,15
		1,00	*0,50*	*1,79*	*0,40*	*0,32*	*229,68*	*1,43*	*0,87*	*1,50*	*0,24*	*15,68*	*1575,68*	*1,03*
MEXICO	2530	0,00	0,48	27,25	0,30	0,34	901,47	2,93	1,94	2,92	0,04	43,05	2154,60	-0,67
		1,00	*0,50*	*10,74*	*0,46*	*0,47*	*1075,88*	*1,66*	*0,81*	*1,59*	*0,20*	*17,37*	*1731,44*	*1,29*
NETHERLANDS	1337	0,00	0,49	15,60	0,21	0,11	944,57	1,88	1,96	4,02	0,13	51,41	2910,06	0,35
		1,00	*0,50*	*5,00*	*0,41*	*0,31*	*496,69*	*1,19*	*0,96*	*1,45*	*0,33*	*16,35*	*1685,94*	*0,74*
SPAIN	3457	0,00	0,50	14,47	0,19	0,13	761,43	1,50	1,68	3,41	0,03	45,12	2305,19	0,20
		1,00	0,50	4,71	0,39	0,34	378,67	1,10	1,04	1,64	0,18	16,41	1683,25	0,84

Source: PISA (2000)

Table 5: Gross and Net differences between private and public school achievement: math

Country	Gross difference [1] (private-pub)	**BEST estimate**		OLS model [2]		Treatment effect model [3]			
		δ (priv)	Probt	δ (priv)	Probt	ρ (corr between error terms)	Probt	δ (priv)	Probt
BRAZIL**	1,0756	**0,4849**	0,0000	0,4849	0,0000	-0,5523	0,0970	0,4307	0,0000
MEXICO	0,7790	**0,0211**	0,8190	0,0211	0,8190	-0,1260	0,1400	0,1019	0,1019
BEL_NL**	0,6358	**0,1630**	0,0010	0,1630	0,0010	-0,1091	0,3320	0,4086	0,0350
BEL_FR(s)	0,5001	**-0,0772**	0,6690	0,2244	0,0000	0,2626	0,0229	-0,0772	0,6690
SPAIN	0,4013	**0,0796**	0,2250	0,0796	0,2250	0,0088	0,8580	0,0201	0,8160
NETHERLANDS	0,2894	**0,0628**	0,2920	0,0628	0,2920	0,5422	0,3670	-0,9227	0,3640
IRELAND**	0,2866	**0,1302**	0,0120	0,1302	0,0120	0,0836	0,2730	0,0122	0,9190
AUSTRIA(s)	0,1200	**-0,1591**	0,0310	-0,1644	0,0060	0,1240	0,0490	-0,1591	0,0310
FRANCE**	0,0713	**0,0982**	0,0420	0,0982	0,0420	-0,2647	0,2200	0,5378	0,1470
DENMARK	0,0087	**0,0389**	0,4780	0,0389	0,4780	-0,0279	0,6800	0,0503	0,4000

** significant at 5%

(s) selection bias significant at the 5% threshold

Table 6: Gross and Net differences between private and public school achievement: reading

Country	Gross difference [1]	**BEST estimate**		OLS model [2]		Treatment effect model [3]			
	priv-pub	**δ (priv)**	**Probt**	δ (priv)	Probt	ρ (corr between error terms)	Probt	δ (priv)	Probt
BRAZIL**	1,1132	**0,4755**	0,0000	0,4755	0,0000	0,0854	0,5930	0,3965	0,0000
MEXICO	0,8950	**-0,0248**	0,6990	-0,0248	0,6990	-0,0345	0,9610	-0,0345	-0,0345
BEL_NL**	0,6779	**0,2403**	0,0000	0,2403	0,0000	-0,1399	0,0900	0,5313	0,0000
BEL_FR**	0,5585	**0,2964**	0,0000	0,2964	0,0000	-0,0246	0,8190	0,3397	0,0600
SPAIN	0,4500	**-0,0070**	0,8820	-0,0070	0,8820	0,0281	0,4280	-0,0847	0,1790
IRELAND(s)	0,4339	**-0,0113**	0,8940	0,1592	0,0000	0,1187	0,0270	-0,0113	0,8940
AUSTRIA**(s)	0,3013	**-0,1895**	0,0000	-0,1139	0,0060	0,1198	0,0060	-0,1895	0,0000
NETHERLANDS**(s)	0,2772	**-0,6844**	0,0210	0,0717	0,1010	0,4199	0,0110	-0,6844	0,0210
FRANCE	0,0277	**0,0143**	0,6630	0,0143	0,6630	-0,1722	0,2230	0,2939	0,2260
DENMARK	0,0096	**-0,0601**	0,1310	-0,0601	0,1310	-0,0787	0,1030	-0,0310	0,4790

** significant at 5%

(s) selection bias significant at the 5% threshold

Table 7: Gross and Net difference between private and public school achievement: sciences

Country	Gross difference [1]	**BEST estimate**		OLS model [2]		Treatment effect model [3]			
	priv-pub	**δ (priv)**	Probt	Estimate	Probt	ρ (corr between error terms)	Probt	δ (priv)	Probt
BRAZIL**	0,8703	**0,5299**	0,0000	0,5299	0,0000	0,0733	0,7480	0,7480	0,0000
MEXICO	0,6696	**-0,0423**	0,6600	-0,0423	0,6600	0,1329	0,1560	-0,1483	-0,1483
BEL_NL	0,5714	**0,0556**	0,3910	0,0556	0,3910	0,0656	0,5560	0,0096	0,9600
IRELAND**	0,4095	**0,2185**	0,0000	0,2185	0,0000	0,0547	0,4610	0,1397	0,2240
BEL_FR**	0,4037	**0,1986**	0,0000	0,1986	0,0000	-0,0009	0,9960	0,2137	0,4630
SPAIN	0,3790	**0,0556**	0,3910	0,0556	0,3910	0,0613	0,2210	-0,0444	0,6100
NETHERLANDS**(s)	0,1789	**-0,9225**	0,0010	0,0006	0,9930	0,5685	0,0020	-0,9225	0,0010
AUSTRIA	0,1516	**-0,0950**	0,1040	-0,0950	0,1040	0,0478	0,4380	0,4380	0,1020
FRANCE	0,0416	**-0,0301**	0,5320	-0,0301	0,5320	-0,2954	0,1230	0,4617	0,1610
DENMARK	-0,0192	**-0,0266**	0,6380	-0,0266	0,6380	-0,0236	0,7320	-0,0128	0,8370

** significant at 5%

(s) selection bias significant at the 5% threshold

Table 8 **-** Net difference between private and public school achievement: recap.

Country	**Math**	**Reading**	**Science**	Average δ (priv)
BRAZIL	yes ++	yes +++	yes +++	0,4968
IRELAND	yes ++	no	yes +++	0,1890
BEL_NL	yes +	yes +++	no	0,1530
BEL_FR	no	yes +++	yes ++	0,1393
SPAIN	no	no	no	0,0427
FRANCE	yes +	no	no	0,0275
MEXICO	no	no	no	-0,0153
DENMARK	no	no	no	-0,0159
AUSTRIA	no	yes --	no	-0,1479
NETHERLANDS	no	yes ---	yes ---	-0,5147
Average δ (priv)	0,0842	0,0049	-0,0058	

yes/no: significant/unsignificant private school effect
+/- avantage/disadvantage private school between 0 and 10% of a standard deviation
++/-- avantage/ disadvantage private school between 10 and 20% of a standard deviation
+++/--- avantage/ disadvantage private school of more than 20% of a standard deviation