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MINISTERIO DE EDUCACIÓN, CULTURA Y DEPORTE

PIRLS - TIMSS 2011

International Study on Progress in Reading Comprehension, Mathematics and Sciences

IEA

VOLUME II: SPANISH REPORT. SECONDARY ANALYSIS

INSTITUTO NACIONAL DE EVALUACIÓN EDUCATIVA

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VOLUME II: SPANISH REPORT. SECONDARY ANALYSIS

MINISTERIO DE EDUCACIÓN, CULTURA Y DEPORTE

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PIRLS - TIMSS 2011

International Study on Progress in Reading Comprehension, Mathematics and Sciences

IEA

Volume II: Spanish report

SECONDARY ANALYSIS

PROLOGUE

The PIRLS and TIMSS studies of the IEA (International Progress Report on Reading Comprehension; Trends in International Study of Mathematics and Sciences, respectively) provide over 60 participating countries with the information needed to improve teaching and learning in the areas of Reading, Mathematics and Science based on the performance data of the students in 4th year of Primary Education and 2nd year of Compulsory Secondary Education. Together with these data, they also contain a wealth of information on the availability of school resources and the quality of the curriculum and teaching. This evaluation provides countries with an opportunity of measuring the progress of educational performance in these three areas, as well as empirical information about the contexts of schooling.

In Volume I of the Spanish Report two studies are desribed: PIRLS and TIMSS (Chapter 1), their results from a general point of view as well as by levels (Chapter 2), its relationship to the social, economic and cultural context (Chapter 3) and the school context (Chapter 4).

Volume II contains the research carried out by several different groups where it has been attempted to link particular social and family aspects to the results obtained in Spain by the students of 4th year of Primary Education, in tests of Reading (PIRLS) and Maths and Sciences (TIMSS).

Six research groups from different disciplines, with extensive experience in the analysis of the results of international educational studies, have carried out reports which integrate Volume II of the Spanish Report of the PIRLS and TIMSS.

The professors at the University of Oviedo, Ángela Blanco, Norberto Corral, Itzíar García, Ana Ramos and Eduardo Zurbano, also point out that language training before entering Primary Education and the reading habits of the student are two of the variables that have a great influence on the results. This cumulative effect is particularly relevant in families with a lower level of education. These authors also find that the education centers play a moderating role with respect to the sociocultural differences from the outset, although some differences remain. And finally, they suggest that parental expectations also influence in their own way both the expectations of the children, as well as their performance.

The paper by Walter Garcia-Fontes, of the Universidad Pompeu Fabra in Barcelona, looks at the effect of reading habits on the academic performance of students in some depth. This author concludes that there is a positive and significant impact of activities of parents reading to their

children, which can cause the student to improve their results in PIRLS by up to 4 deciles, ie: the student will go, for example, from being far behind and with a high likelihood of repeating a year, to being around the class average. On the other hand, the parents' own reading, without the reading with their children, has an indirect effect through the number of general and children's books in the home. The lower family involvement in student learning in Spain may partly explain the results of our country.

Professor José García-Montalvo, of the University Pompeu Fabra in Barcelona, points out that the quality of education is very important in the economic development of a country and indicates that there is evidence that shows that 25 points more in PISA would have a positive effect on Spain's economic growth in the long term, as large as three times our GDP. It is logical to assume that something similar will happen with TIMSS and PIRLS. This author shows evidence of the positive effect on the results of having been born in the first and second terms of the year, entering into Primary Education at 6 years old, or of the teacher having more than 5 years of experience. In subsidized and private schools the socio-economic effect on the results is less than in the public schools.

The study of professors Marisa Hidalgo and José Ignacio García Pérez, of the Universidad Pablo de Olavide of Seville, points out that, using the data of PIRLS and TIMSS, students who attended Pre-school Education for at least three years got about 16 points more in reading tests than those children who did not attend Pre-school Education. This positive effect manifests itself mainly by the fact that attendance of Pre-school Education significantly reduces the likelihood of getting low scores, especially for students who do not have university-educated mothers or fathers.

A professor at the University of La Laguna, Saturnino Martínez and Dr. Claudia Cordoba at the same university, conclude that the socio-educational level of the parents is a factor which influences reading performance, to which the participation in the labor market of mothers must be added, and which is something that positively affects daughters more than sons. Boys and girls from families that encourage an interest in reading achieve better results, even if they are families with disadvantaged circumstances. The teaching methods of the teachers that promote an interest in reading and the exposure to different types of texts also produce positive results.

Finally, professors Javier Tourón (Universidad de Navarra), Luis Lizasoaín (Universidad del País Vasco), María Castro (Universidad Complutense de Madrid) and Enrique Navarro (International University of La Rioja) show that the conditioning factors of student results are different depending on where they come in the levels of low, medium or high student performance. Among other variables, the liking for mathematics has a high impact on the academic performance of TIMSS-Mathematics for underachieving students. In the intermediate group the effect of the variables is less significant. The students who get high performance, meanwhile, do so regardless of whether they like the subject more, or less.

The studies presented in this volume and those that may arise from further research studies will undoubtedly help to draw conclusions and recommendations that should help the academic authorities to make decisions aimed at improving the results of students, at reducing

the percentage of early drop-outs from education, and training in accordance with the guidelines of the European Union.

Chapter 1

Structure of the Family Educational Environment:

Its Influence on Performance and Differential Performance

STRUCTURE OF THE FAMILY EDUCATIONAL ENVIRONMENT: ITS INFLUENCE ON PERFORMANCE AND DIFFERENTIAL PERFORMANCE

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INTRODUCTION

We could define education as a process of socialization of individuals in which knowledge, beliefs, customs, values, emotions and, in general, ways of life are transmitted. It is a very broad concept which has a globalizing character since it completely affects the present and future life of children.

By the late sixties of the last century the discriminations between formal, non-formal and informal education became more frequent taking into account the different contexts in which these tasks can be carried out.

Thus, by formal education we mean that which is imparted in schools, colleges and training institutions; non-formal is that which is associated with community groups and organizations and civil society; and informal covers everything else, i.e., interaction with friends, family, colleagues and fellow citizens. In practice, due to the nature of the educational phenomenon, the boundaries between these categories are easily blurred. For example, a teacher in his/her work (which would correspond to formal education) can use as teaching resources some ICT media which belong to informal education, or a visit to a museum with information provided by a technician which would correspond to non-formal education.

If we consider the period prior to schooling, we find that children always receive and take the foundations for their initial education from their family and their immediate surroundings. Therefore, the child's first contact with his/her education has an informal character.

Thus, starting from the results of the present PIRLS 2011 Study, we are going to be concerned in this article with exploring the influence diverse social and family factors may have on the

linguistic competence training of children. We will analyze issues such as the level of family education, understood as the highest academic level of either parent; the possibility that in his/her family environment the child would have had experiences that could have encouraged his/her love of reading; which had been stimulated through activities such as stories, poems or games; or had been exposed to patterns of family behavior that inspired their reading habits. All these factors correspond to informal learning.

We will also study the relationship between the results obtained from the PIRLS tests and the linguistic proficiency level with which the child entered into Primary Education having gone through Pre-School Education. This corresponds to formal learning.

We haven't found data in the study that would allow us to analyze the possible influence of non-formal learning, such as the fact that the child had been integrated into organized activities as theater or physical expression, games workshops, artistic expression or music, etc.

We have also related the performance of students to their corresponding center of Primary Education in order to analyze how that institutionalized educational context is associated with the social factors discussed above.

Finally, we have been exploring the relationship between the performance of children and their parents' expectations about the level of education they expect their children to reach. This is an aspect with a strong emotional component which may involve situations of anxiety, shown either implicitly or explicitly.

METHODOLOGICAL FRAMEWORK

The analyzed data correspond to the PIRLS 2011 report and contains information on students, mothers/fathers, teachers and schools, collected through context questionnaires. It concerns opinions or assesments given by the respondents and which may have a high degree of subjectivity which must be taken into account, both in the analytical procedures which are used as well as in the conclusions drawn.

For example, in the exploratory phase of the data it was revealed that approximately 90% of parents who responded to the questionnaires did the following every day, or almost every day: "Speak to their children about their classwork", "Make sure that they set aside time for homework", "Check that their children did their homework", etc. This indicates a strong interest of families in the education of their children. However it is also possible that amongst those who claim to do these activities with their children there could be very important differences, both in terms of how to address them as well as the time spent on them. That has not been detected in the report data.

It would have been very interesting to include in our study other socioeconomic indicators that clearly influence the Family Educational Level but there is no explicit information in the PIRLS 2011 questionnaires on the economic level of the family and the categorization of the type of work of the mother or father is too broad. For example, the "Small business owner" category includes owners of small businesses of between 1 to 24 employees, which may correspond to very different types; "Executive or high-level employee" includes all army officers, from Lieutenant to General; "Technicians or assistants" includes, among other professions, engineers, IT specialists, business brokers or administrative assistants, all professions with profiles that may differ greatly.

In this sense, José Saturnino Martínez García and Claudia Córdoba point out in their study "Performance in Reading and Gender: A small difference motivated by social factors" (included in this PIRLS 2011 Report) that the information from PIRLS "is somewhat scant to accurately develop indicators of social position most often used in the study of inequality of educational opportunities".

One aspect to take into account is the distribution of non-responses in the different variables, which are not distributed randomly but are concentrated primarily in students with lower scores in language tests.

Exploratory analyses of the data were the basis for determining the objectives and procedures of the study and for recodifying some of the variables.

The variables that appear in this study are the following:

Family Educational Level (FEL). This indicates the highest level of education attained by the mother or father of each student. The categories taken into account are:

- “Doesn't know/No answer”
- “Unfinished Compulsory”
- “Finished Compulsory”
- “Mid-Level Vocational Training and/or Bachillerato”
- “High-Level Vocational Training + Diploma + Technical Engineers”
- “Graduates + Senior Engineers”

The label "High Level Vocational Training + Diploma + Technical Engineers" refers to those parents who have a High Level Vocational Training or a mid-level University degree, such as a Diploma or Technical Engineering. The reason for considering them together is that the profiles we have been provided with are very similar in the three groups. It is interesting to see that the High Vocational Training and University Diplomas resemble each other more than the Diplomas and Graduates.

Early Language Training (ELT). This is a global indicator of the knowledge in Language that the children had on starting Primary Education. It is related to aspects such as "recognizing some letters", "reading words", etc. The categories are: "Bad", "Fair" and "Good".

Early Language Activities (ELA). This variable refers to the frequency and type of activities that the parents did with children before Primary Education, such as, for example, "reading books", "telling stories", "playing word games", etc. The categories are: "Nothing / Infrequent" and "Often".

Time Attending Infant School. This shows the years that the children attended Nursery Education. The categories are "Less than three years" and "Three or more years."

Parents' Expectations on the future Educational Level of their children. This reflects the educational level that the parents expect their children to achieve. The categories are: "Compulsory", "Post-compulsory" and "University".

Reading Habits of Parents (RHP). This shows how much parents read. The categories are: "Little", "Average" and "A lot".

Reading Habits of Students (RHS): Indicates how much the students read. Initially, the categories were: "Little", "Average" and "A lot".

Language Performance. This variable is represented by the five general plausible values for language in the PIRLS tests.

Age of admission into Primary. This is a variable indicating the age at which the child has entered into Primary Education. The categories used initially were "5 years", "6 years" and "7 years or more."

Performance Differential. This variable is defined as the difference between a student's performance and the average performance of students of the Primary Education school that they attend. This means that the differential reflects the relative knowledge of a student with respect to that of all of his/her schoolmates.

Income level of the area. It indicates the average income in the area where the corresponding Primary Education school is located. The initial categories are: "High", "Medium" and "Low".

The absence of a response for qualitative variables was codified as "DK/NA", i.e. "Doesn't know/No answer".

The estimation of the parameters associated with Language Performance (average values, percentiles, standard errors, etc.) was carried out firstly for each of the five plausible variables, and later the estimates were averaged out.

The two-staged sampling by clusters used to collect the sample data entails that the accuracy of the estimates is less than in the case of a simple random sampling. Therefore, several tests were carried out on the procedure to be used in order to approximate the standard error of the estimates. Standard procedures as well as some computational-intensive techniques such as Bootstrap, Jackknife, etc. have been considered. Since the results were practically identical,

we decided to use the Jackknife procedure which is based on resampling and it adapts well to the structure of the sample as well as it is not very computationally expensive.

In the exploratory analyses of the data the SPSS Statistics Package was used to link different databases, to record variables, etc. On the other hand, the R package and some of its specific libraries (such as Survey) were used for graphs, the estimation of the parameters of interest, the approximation of standard errors, etc.

Given the nature of the questionnaires and the potential subjectivity of the responses, we have tried to limit the conclusions to combinations of factors that will affect at least a hundred students, in order to moderate the imprecision of the questionnaire data and to obtain sufficiently precise estimates. In the data analysis we have employed methods that do not require prior assumptions which are difficult to verify in a complex design, as far as possible. We have also tried to present the results in the most possible informative way.

RESULTS OF THE STUDY

As commented in the introduction, it is widely agreed that the environment in which children develop represents an essential context in their education. In this sense, the second half of the last century marks the beginning of the search for empirical evidence which shows the relationship between educational performance and social factors in general (Symenou, 2005).

Within these social factors, those regarding the family environment explain the differences in learning achievements to a greater extent than the others (Martínez, 1992; Molero, 2003, González-Pienda, 2003). This constitutes a basic principle in the study of education nowadays (García, 2003).

Therefore, the influence of the family environment on the success of the learning processes carried out in schools has long been widely accepted by the various educational agents (Gil, 2009).

In this context, the PIRLS 2006 Report (MECD, 2007) took into consideration the students' sociocultural models in order to properly contextualize their performance in reading. It showed how the sociocultural context of families and educational resources at home were the factors which apparently affect most the learning process of reading (in all the countries, without exception).

In the following we will analyze the interrelation between the student Performance and Family Educational Level **(**FEL). Before proceeding to the detailed study it is interesting to comment that the average performance of the students whose parents did not respond to FEL is slightly higher than that of the category "Unfinished Compulsory". This result will be repeated almost systematically in the forthcoming analyses.

The category "DK/NA" in FEL has been studied in some detail, since it represents nearly 14% of the sample and its removal would result in an overestimation of the average performance in Language.

It would be safe to assume that the profile of parents whose FEL is "DK/NA" corresponds mainly to the categories "Unfinished Compulsory" and "Compulsory", i.e. with lower levels of education. With these reservations, we now move on to the analysis.

Relationship of Performance with Family Educational Level (FEL)

In this section the behavior of the Performance variable is analyzed by taking into account the different groups of Family Education Level of the students.

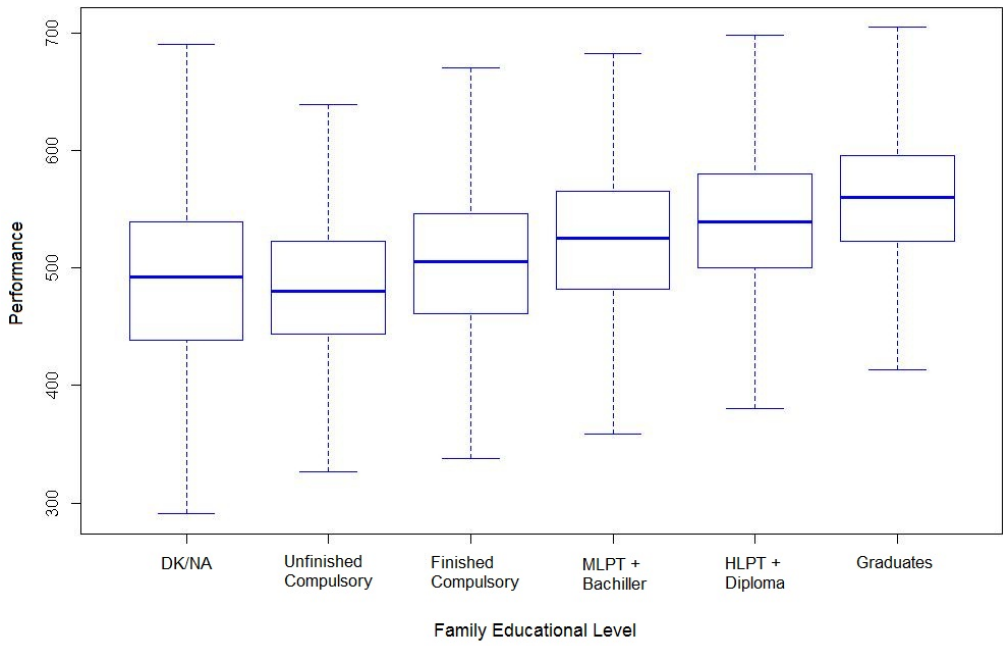
Table 1.1. Relacionship between Performance and Family Educational Level

	Family Educational Level					
Performance	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates
N. analyzed	1133	509	1600	2541	1321	1476
Average	481,3	480,1	496,3	515,4	526,3	551,1
Standard Error	5,2	3,9	2,7	2,7	4,1	3,5

The results in Table 1.1 clearly show the relationship between Performance and FEL, since the Performance average grows by approximately 20 points from each educational level to the next. This result is very similar to the one in the PIRLS 2006 Report, with some differences that may be attributable to some extent to a different categorization of the family education levels.

The results do not imply that the Family Educational Level strongly determines Performance, since it can only predict about 12% of it. In fact, the performance distributions in Language show a great overlapping between the different categories, as shown in Figure 1.1.

Figure 1.1. Performance according to Family Educational Level



This means that Family Educational Level is not a good predictor of a student's specific score, but it is very useful when we want to make inferences about more general indicators, such as the probability that a given group exceeds a fixed score.

In Table 1.2 we analyze the percentage of students who score above the 50 and 90 percentiles of the sample, in order to try to explain the differences associated with the Family Educational Level. We thought that these two percentiles were a correct choice for the following reasons: P50, because the division of the entire distribution into two equal parts sets a sort of psychological limit which is socially recognized; and P90 shows performances coming from the 10% of the best performing students and which is usually identified with "excellence".

Table 1.2. 50th and 90th Percentiles of Performance and Family Educational Level

Performance	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates
% Values> P50	33 %	24 %	38 %	51 %	61 %	74 %
% Values > P90	4 %	2 %	5 %	8 %	14 %	24 %

The percentage of students who score above the 50th percentile go from 24% in the "Unfinished Compulsory" group to 74% in the "Graduates" group, with an almost constant increase of 13-14 percentage points when passing from one category to the next. There is an exception in the "HLVT + Diploma" group; it is a category that seems to be closer to the "MLVT + Bachiller" group than to the "Graduates" group, as it has been already noted.

As commented before, the "DK/NA" category is between the two lowest groups of Family Educational Level. No wonder that the group "MLVT + Bachiller" (which corresponds to what we might call an average level of education) has an average level (51%) in the percentage of students in that category whose performance leads half of the survey population.

By comparing the percentage of students who score above the 90th percentile we confirm even more strongly that the distribution of the best students is closely related to the Family Educational Level. It moves from 2% in families with "Unfinished Compulsory" education up to 24% in "Graduates" group.

In the report carried out by Touron and others (included in this volume), percentiles of 10, 45-55 and 90 are used to define the groups of students with "Low", "Medium" and "High" Performance in Mathematics (TIMSS assessment). In their work they point out that performance in Mathematics is also related to the socio-economic family environment.

In summary, these results clearly show the disadvantageous position of students who come from families with a lower level of education.

Relationship of Performance with the rest of the associated factors

Language Performance is clearly related to all the tasks proposed to encourage and promote reading activities. The research literature has extensively shown how the habit of reading has a positive influence on the scores in Language in all the cases (Fernández, García and Prieto, 1999; Ruiz, 2001; Cromley, 2009; Gil, 2011).

Meanwhile, the PIRLS 2006 Report concluded that the more hours per week that parents devote to reading at home (books, press or work-related material), the better are the performances obtained by students in the tests.

From the preceding considerations about the significant influence that the Family Educational Level has on performance, we found it interesting to determine how these four family factor variables concerning reading habits are interrelated, and whether any of them can manage to mitigate the observed differences. Although the Family Educational Level obtained from the current PIRLS-data cannot be modified, we will analyze if these activities (some of them organized through the curriculum) can compensate the structural differences which are linked to the Family Educational Level.

Performance according to Reading Habits of Parents and Students

Firstly, we analyze the performance according to the reading habits of parents and reading habits of students. The results are shown in Table 1.3. As expected, the performance is associated with these two factors.

Table 1.3. Performance according to Reading Habits of Students and Reading Habits of Parents

Performance according to Reading Habits of Students	N. analyzed	Average	Average Standard Error
DK/NA	77	477,3	11,8
Little	1182	494,6	3,8
Regular	4647	504,8	2,8
A lot	2674	536,6	2,7
Total	8580	513,1	2,6

Performance according to Reading Habits of Parents	N. analyzed	Average	Average Standard Error
DK/NA	717	486,4	7,3
Little	1061	493,5	3,3
Regular	4166	510,7	2,8
A lot	2636	532,0	2,9
Total	8580	513,1	2,6

Note that Performance according to the reading habits of parents or students are very similar: the differences between the categories of "Little" and "A lot" are 42 points for students and 39 points for parents.

For Reading Habits of Parents factor the average performance for the students whose parents did not respond is clearly lower than those corresponding to parents who read “Little”.

For Reading Habits of Students there is a great difference between "Little" and "Regular". For this reason, they will be joined together in forhtcoming analyses.

Performance according to Early Language Training and Early Language Activities

The analysis confirms that Performance is clearly related to both Early Language Training as well as Early Language Activities. See Table 1.4.

Table 1.4. Performance according to Early Language Training and Early Language Activities

Performance according to ELT	N. analyzed	Average	Average Standard Error
DK/NA	725	486,6	7,4
Bad	1252	478,4	3,4
Fair	3163	505,9	3,8
Good	3440	535,8	2,3
Total	8580	513,1	2,6

Performance according to ELA	N. analyzed	Average	Average Standard Error
DK/NA	706	487,5	7,1
Never-Sometimes	4407	505,7	2,6
Often	3467	527,6	2,8
Total	8580	513,1	2,6

In both cases, each factor positively affects the Language scores of the students. On the other hand, the Performance in the "DK/NA" categories is again similar to that of the students with "Bad" Early Language Training.

It can be remarked that the difference in the average Performance between "Good" and "Bad" categories of ELT is about 60 points, while in the remaining three factors the difference between the most extreme categories is less than 46 points. Therefore, it could be concluded that the most relevant of the four considered factors is a good training in linguistic competence in Pre-school education. Thus, the importance of a good educational work in the key stage of Pre-school education is reflected.

JOINT ANALYSIS OF THE FAMILY EDUCATIONAL LEVEL WITH THE OTHER FACTORS

One interesting aspect may be to study the relationship between Family Education Level and the other factors we have analyzed so far. For example, to check whether a higher family education level corresponds with: higher reading rates in parents and students, a higher frequency in the early activities to develop language skills, a more solid training in these skills when entering Primary Education,…

Analysis of the Family Educational Level with each of the factors

In Table 1.5 it is shown how the language-related activities, such as "reading stories", "telling stories", "inventing situations", "word games", etc. are less common among families with lower levels of studies than in the rest. However, notice that in the “Graduates” group only 54% of the parents frequently perform such activities with their children. This could be attributed to a lack of time, but also, perhaps, to a lack of awareness of the importance of such activities.

Table 1.5. Relationship between Family Educational Level and Early Language Activities

	Family Educational Level						
ELA	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
Never-Sometimes	73%	73%	63%	54%	49%	46%	56%
Often	27%	27%	37%	46%	51%	54%	44%

The language training of the students when they start Primary Education shows relevant differences in Table 1.6. For low Family Educational Levels the percentage of students with “Good” ELT is around 30%. On the contrary, students belonging to families with higher educational levels is almost double (58%).

It is also shown that when the training is "Fair" or "Good", there are clearly two clusters; one cluster with “Unfinished Compulsory” and “Finished Compulsory” categories, and another one

with “MLVT + Bachiller” and “HLVT + Diploma”. The category of "Graduates" is clearly distinguished from the others.

Table 1.6. Relationship between Family Educational Level and Early Language Training

	Family Educational Level						
ELT	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
Bad	19%	26%	19%	16%	14%	11%	16%
Fair	44%	44%	47%	41%	39%	31%	40%
Good	38%	30%	34%	43%	47%	58%	44%

Table 1.7 and Table 1.8 show the relationships between Family Educational Level and the reading habits of parents and students, respectively.

Table 1.7. Relationship between Family Educational Level and Reading Habits of Parents

	Family Educational Level						
RHP	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
Little	18%	28%	23%	13%	7%	4%	13%
Regular	63%	55%	56%	55%	52%	43%	53%
A lot	19%	17%	21%	32%	41%	53%	34%

Reading Habits of Parents is a variable in which differences are quite pronounced. The percentage of parents who read "A lot" is close to 20% in the two lowest groups of Family Educational Level, and it becomes 53% in the “Graduates” group. Despite of the fact that this percentage is not very high, it can be remarked that only 4% of the parents in this category responded "Little".

Table 1.8. Relationship between Family Educational Level and Reading Habits of Students

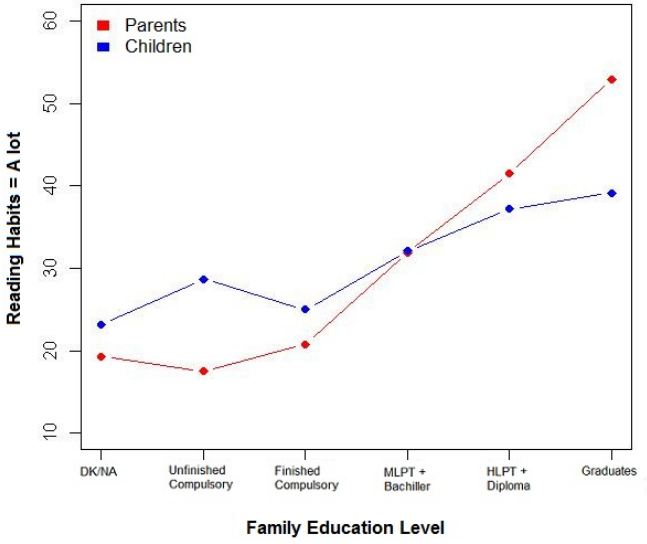
	Family Education level						
RHS	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
Little	15%	11%	19%	13%	13%	11%	14%
Regular	62%	60%	56%	55%	50%	50%	55%
A lot	23%	29%	25%	32%	37%	39%	31%

The differences in the taste for reading of students from the 4th year of Primary Education polled in PIRLS 2011 Study are also important. Those who read "A lot" range from 25-29% in the families from the two lowest groups of Family Education Level. It is 39% in the group of

"Graduates". Nevertheless, the differences are clearly smaller than those obtained for the parents.

In Figure 1.2 we have combined the results of the category "A lot" in Tables 1.7 and 1.8, i.e. for the Reading Habits of parents and students.

Figure 1.2. Comparison of Reading Habits between parents and children



We see how they the percentages cross over: For low levels of education, the children read more than parents; in the middle levels percentages are even; and at higher levels it is the parents who read more than their children, even with a greater difference in percentage points than in the other categories.

This may indicate that if students from groups with a low Family Education Level in the future get a higher grade in FP or a University degree, they will possibly end up getting better results than their parents in terms of reading habits.

In Table 1.9 the relationship between the years spent in Pre-school education and the achievements in the variable Early Language Training is shown.

Table 1.9. Years attending Pre-school education and Early Language Training

	Early Language Training			
Years in Pre-school education	Bad	Fair	Good	Total
less than 3 years	22%	45%	33%	100 %
3 or more years	12%	39%	49%	100 %
Total	15%	41%	44%	100 %

Perhaps it would be interesting enlarge the time of attendance in Pre-school education schools: 49% of children that attend three or more years to this educational stage behave

"Good" in language tasks, while that percentage drops to 33% in the rest.

However, what seems to happen in Table 1.10 is just the opposite. Children who come from families with lower educational levels spend less time in the Pre-school education schools than the others. A difference of 22 percentage points between the extreme groups of Family Educational Level is obtained.

Table 1.10. Years in Pre-school education and Family Educational Level

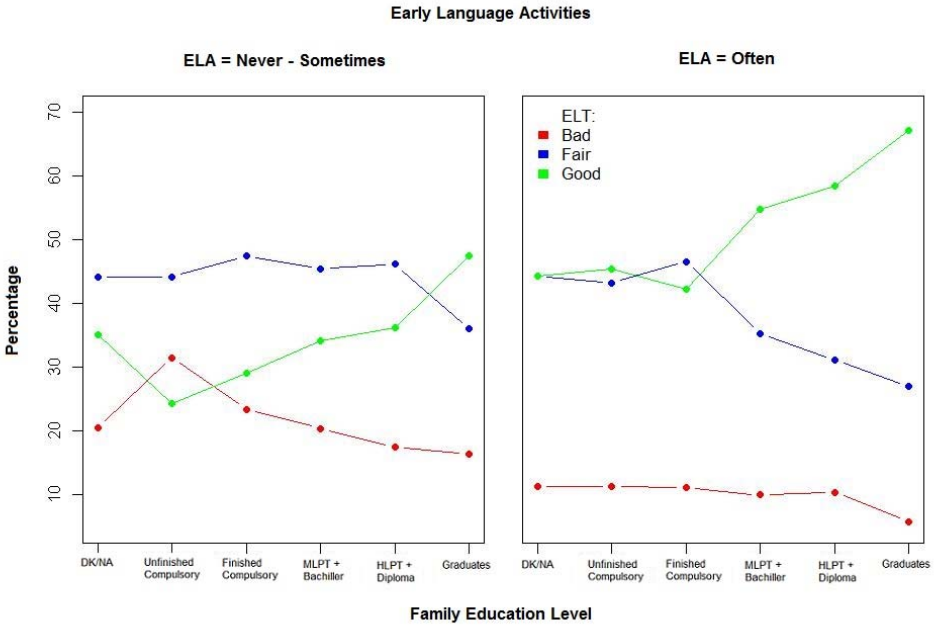
	Family Educational Level						
Years in Pre-school education	DK/NA	Unfinished Compulsory	Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
less than 3 years	44%	42%	40%	34%	26%	20%	32%
3 or more years	56%	58%	60%	66%	74%	80%	68%

As we can see, all of the results go in the same direction. The sociocultural level of the parents is the factor that seems to have the greatest influence. It affects not only the performance obtained by the children, but also the other involved factors.

Joint Study of Family Education Level with Early Language Training and Early Language Activities

Another interesting aspect is to analyze in detail the relationship between Early Language Training and Early Language Activities, and its relation with Family Educational Level (see Figure 1.3).

Figure 1.3. Family Education Level with Early Language Training according to Early Language Activities



The left-side figure corresponds to families that performed Early Language Activities "Never-Sometimes". It can be seen that the percentage of students who have a "Bad" Early Language Training goes down progressively as the Family Educational Level rises. This relationship is reversed when analyzing the percentage of students with a "Good" Training, since it grows from 24% in "Unfinished Compulsory" group to 48% in "Graduates" group.

The right-side figure shows that among parents who "Often" perform Early Language Activities with their children, the percentage of students with "Good" Early Language Training improves when the Family Educational Level does. In "DK/NA", "Unfinished Compulsory" and "Finished Compulsory" groups, the percentage of children who behave "Good" in Training is stabilized around 40-45%. The percentage rises abruptly to almost 70% in "Graduates" group.

Carrying out these activities "Often" seems to be effective: the percentage of "Good" Training increases between 15% and 20% in all categories. The encouragement is essential for learning.

On the other hand, whereas a difference of 28 percentage points between the highest and lowest Family Educational Level for the "Good" category of Early Language Training has been obtained (Table 1.6), for the "Often" category of Early Language Activities the difference decrease to about 21 points (Figure 1.3).

It is noticeable that the families from the "Unfinished Compulsory" group which frequently carry out language activities with the children almost reach the same percentage of Early Language Training as the families of "Graduates" with activities "Sometimes".

It can be realized from the results that the structural differences from the outset are difficult to overcome. Nevertheless, if we act jointly and systematically on some factors at the same time we are perhaps able to reduce these differences significantly.

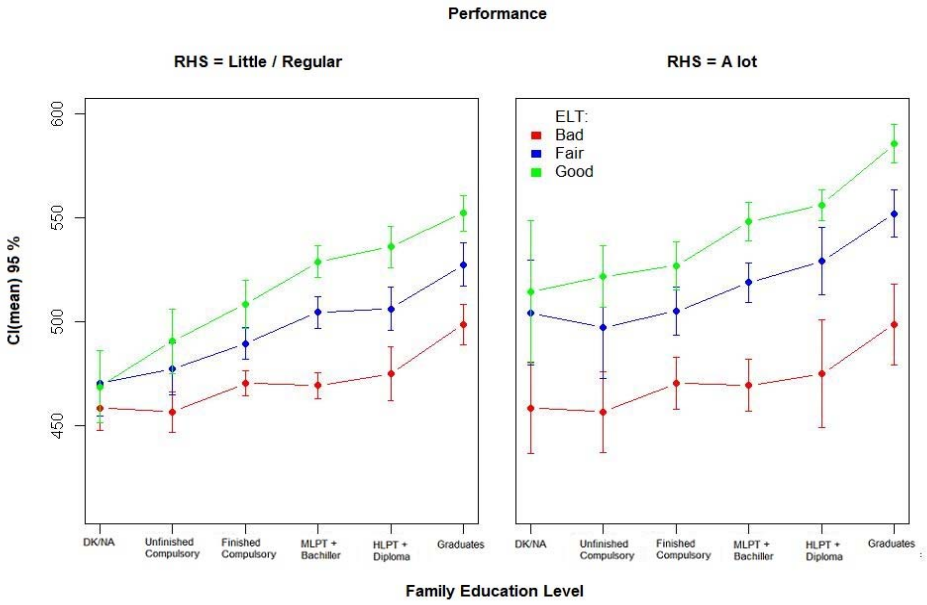
Joint Study of Family Education Level, Early Language Training and Early Language Activities with Performance

Given the above results, we are going to study to what extent the combination of the factors "Family Education Level", "Early Language Training" and "Reading Habits of Students" interacts with Performance. The inclusion of these last two factors in the study is due to the fact that they are susceptible to being reinforced in a short period of time, since it is possible to plan and implement actions upon them.

The obtained results are shown in Figure 1.4. They confirm those discussed in the individual comparisons. They indicate a systematic and cumulative improvement in Performance according to the three involved factors. The two figures have a similar behavior, with linear growth and similar slopes. This suggests that the effects of the factors are additive and they have small interactions.

By analyzing jointly the two figures we see that if the Early Language Training is "Bad", Performance is hardly affected by Reading Habits of Students. This is not the case if the Early Language Training is "Fair" or "Good", since a steady increase in Performance is obtained when increasing the reading rates.

Figure 1.4. Performance according to Family Educational Level, Early Language Training and Reading Habits of Students



It is important to highlight that the combination of a good level in Language and also good reading habits can help students in groups of lower levels of family education to exceed the average performances.

Age of the students

At so young ages of children considered in this study it is reasonable to think that there must be significant differences in performances depending on age. To that end, we have obtained the results of the students according to their age on starting Primary Education:

Table 1.11. Students' age of entry into Primary Education and Performance

Entry age	N. analyzed	Average	Standard error
DK/NA	860	491,2	6,3
5 years	3611	507,2	2,9
6 years	3977	524,7	2,4
7 years or more	132	466,8	12,0
Total	8580	513,1	2,6

The first interesting point to comment is the group of pupils entering Primary Education at 7 years old or more. In the Spanish Educational System, the entry into Primary Education takes place in the year in which the child turns six years old. Thus, it is reasonable to assume that in that group we are most likely dealing with children of immigrants or from disadvantaged groups. We also notice that the size of that group is very small, the average performance is very low and the error is large. Therefore, it will not be included in forthcoming analyses.

We can see in Table 1.11 that students who began Primary Education at the age of 6 obtain results which are slightly higher than those who had not yet turned 6. Such results confirm those presented in the PIRLS 2006 Report. Whereas the difference in the age of students is not considered an important factor in other countries studies, in Spain slight differences between students who has born in the first term and those who born in the fourth term of the same year are obtained.

Nevertheless, in this study the differences seem to be more related to Early Language Training than to age, as shown in Table 1.12.

Table 1.12. Age on starting Primary Education and Early Language Training

Early Language Training	Age starting Primary	N. analyzed	Average	Standard error
Bad	5 years	750	475,3	4,3
	6 years	425	487,7	6,2
	Total	1175	479,8	3,9
Fair	5 years	1551	503,0	3,0
	6 years	1484	510,1	2,6
	Total	3035	506,5	2,3
Good	5 years	1273	531,3	3,5
	6 years	2051	543,3	3,0
	Total	3324	538,7	2,8

Note that students who started at five years old and who are in the "Good" category of Early Language Training outperform students who are six years old in the lower grades.

These results agree with those appearing in the Marisa Hidalgo and Ignacio García's work (from the same PIRLS 2011 database), in which a more detailed analysis of this issue is made.

This set of results suggests that in the fourth year of Primary Education, although age is a factor that relates to performance, the level of initial training in language is more important. On the other hand, attendance for three or more years in Pre-school education improves performance, and it is especially useful for students who begin Primary Education at five years old and they come from families with a lower level of education.

This can lead to a discussion about when it is more convenient to enter Primary Education: according to the date of birth, or when the students have achieved certain skills and they have reached a certain level of psycho-evolutionary development.

Performance Differential with respect to the school

In this section we are going to deal with Performance in relative terms, that is, with respect to the specific school that the student attends. In this way, we have the possibility of anchoring the performance of each student to their school environment, to the ecosystem in which he/she is developing, and we can compare the Differential Performance with the other considered factors.

To do this, from each of the five general plausible values obtained in the PIRLS 2011 tests the corresponding plausible differential value was constructed for each variable, as the difference between the plausible value of each student and the average plausible value of the school he/she attends. The estimation of the parameters associated with the Performance Differential follows the same criteria as those applied to Performance.

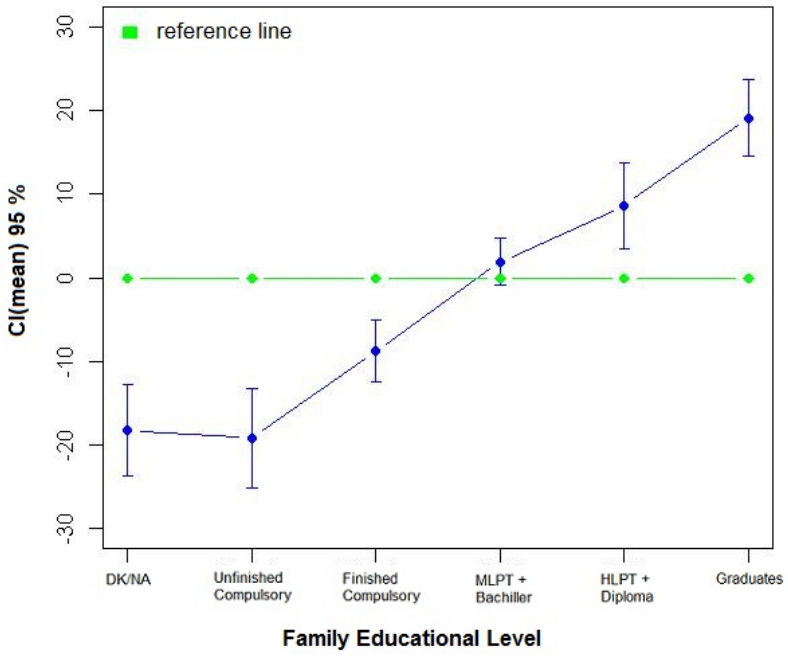
Table 1.13. Performance Differential and Family Educational Level

Differential	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates
N. analyzed	1133	509	1600	2541	1321	1476
Average	-18,3	-19,1	-8,8	1,9	8,7	19,2
Standard Error	2,7	3,0	1,9	1,5	2,6	2,3

The results shown in Table 1.13 indicate that a relationship between Family Education Level and Performance Differential still exists. It can be seen when comparing the average differential of -19 points in the "Unfinished Compulsory" group to the value of 19 points in the "Graduates" group. Consequently, we can say that the level of family studies remains a factor that strongly influences the performance of the students, even when they receive the same formal training.

However, it is clear the moderating role of the school with respect to the relationship of the Family Education Level with Performance, since the differences between two consecutive levels have become about 10 points, practically half of those observed in Table 1.1 (about 18 points). Figure 1.5 shows more visually what we are describing.

Figure 1.5. Performance Differential and Family Educational Level



In the same vein, the percentage of students who score above the 50th percentile of the sample (Table 1.14) leads to significant differences. They rise from 37% in the group of lowest Family Education Level to 63 % in the group whose level is higher. These percentages increase on average about 6 points when moving from one category to the next. Let us remember that in Table 1.2, in which the individual scores are not indexed to those of the school, those percentages fluctuated between 24% and 74%, increasing approximately 13 points when moving from one category of FEL to the next.

Regarding the 90th percentile, important differences are also seen between the different levels of family studies. The percentage goes from 5% in "Unfinished Compulsory" group to 17% in "Graduates" group. If we compare them with the results in Table 1.2, we see that again there is a certain compensation of the inequalities, since the percentages in Table 1.2 fluctuate between 2% and 23%.

Table 1.14. 50th and 90th Percentiles of the Performance Differential and Family Educational Level

Differential	DK/NA	Unfinished Compulsory	Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates
% Values> P50	37 %	37 %	43 %	53 %	57 %	63 %
% Values> P90	5 %	5 %	8 %	9 %	13 %	17 %

The comparison between the Performance Differential and the Reading Habits of Parents, Early Language Activities, Early Language Training and Reading Habits of Students factors leads to similar results. See Table 1.15.

Table 1.15. Performance Differential with respect to RHP, RHS, ELT and ELA

Table 15 (a). Performance Differential with respect to Reading Habits of Parents and Reading Habits of Students

RHP	N. analyzed	Average	Standard Error
Little	1061	-15,8	2,5
Regular	4166	-1,6	1,2
A lot	2636	12,65	1,5

RHS	N. analyzed	Average	Standard Error
Little	1182	-15,8	2,5
Regular	4647	-1,6	1,0
A lot	2674	12,7	1,5

Table 15 (b). Performance Differential with respect to Early Language Training and Early Language Activities

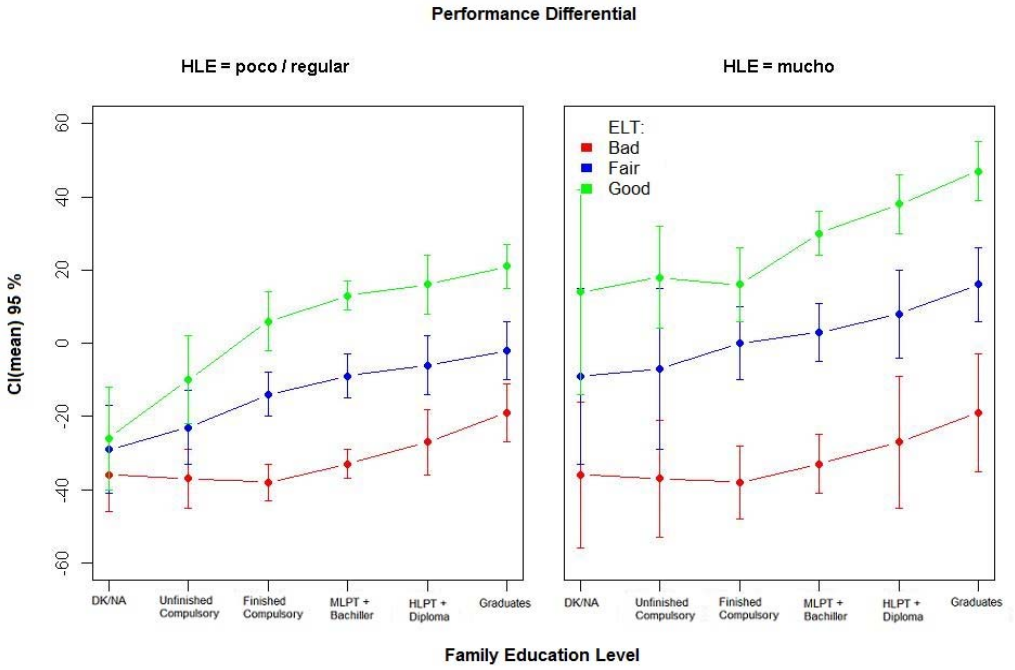
ELT	N. analyzed	Average	Standard Error
Bad	1252	-27,6	2,6
Fair	3163	-7,0	1,2
Good	3440	19,6	1,1

ELA	N. analyzed	Average	Standard Error
Sometimes	4407	-5,5	1,0
Often	3467	10,0	1,2

Indeed, in Reading Habits of Parents there is a difference between the categories "Little" and "A lot" of 28 points for the Performance Differential against 38 points for the Performance; in Reading Habits of Students it is 28 against 40; in the Early Language Training the difference between "Bad" and "Good" is 47 points against 59; and in Early Language Activities the difference between "Never-sometimes" and "Often" is 15 points against almost 22.

Given the connection between these factors, it may be advisable to simultaneously analyze the relationship of the Performance Differential with Family Educational Level, Early Training Language and Reading Habits of Students. See Figure 1.6.

Figure 1.6. Performance Differential for Family Educational Level, Early Language Training and Reading Habits of Students



It is striking that for the two lowest groups in the Family Educational Level, if Reading Habit of Students is "A lot" and Early Language Training is "Good", then the Performance Differential is slightly lower than that for the two highest groups in Family Educational Level and with Reading Habit of Students being “Little-Regular”.

Besides, if Early Language Training is "Bad", the act of reading more or less barely seems to have any influence on the Performance Differential This fact does not happen if ELT is "Fair" or "Good".

Moreover, the relationship of Performance Differential with the age of entry into Primary Education Level is shown in Table 1.16. A change of 11 points is obtained in the Differential Performance scores going from 5 to 6 years old. Let us recall that the difference between Performance scores (Table 1.11) was 17 points. There is still certain compensation in the inequalities.

Table 1.16. Differential with age of entry into Primary Education Level

Age	N. analyzed	Average	Standard Error
5 years	3611	-4,2	1,2
6 years	3977	7,4	1,0
Total	7588	1,9	1,6

If we simultaneously consider the age of entry into Primary Education Level and Early Language Training, the inequalities in the scores remain. See Table 1.17.

Table 1.17. Performance Differential with age of entry into Primary Education and Early Language Training

ELT	Edad Inicio Primaria	N. analyzed	Average	average Standard Error
Bad	5 years	750	-27,6	3,0
	6 years	425	-25,4	5,3
	Total	1175	-26,8	2,7
Fair	5 years	1551	-9,0	1,8
	6 years	1484	-4,7	1,9
	Total	3035	-6,9	1,3
Good	5 years	1273	15,5	2,3
	6 years	2051	23,3	1,6
	Total	3324	20,3	1,2

In Table 1.12 a maximum difference of 68 points is obtained, more or less evenly distributed among the different levels. Now in Table 1.17 we see that the difference is 50 points. As in Table 1.12, it is also confirmed that there is a larger difference between “5 years” to “6 years” for students with "Good" than in the other ELT groups.

It is worth highlighting the fact that Performance Differential only exceeds zero in the students whose Early Language Training is "Good" (regardless of age. This clearly indicates the importance of this factor.

It is also interesting to quantify the role of the school to balance the differences associated with different levels of family education. In Spain, the social inclusion rate is higher than the OECD average and the degree of social and academic segmentation is not a great concern (see the report of Martínez and Córdoba, included in this volume).

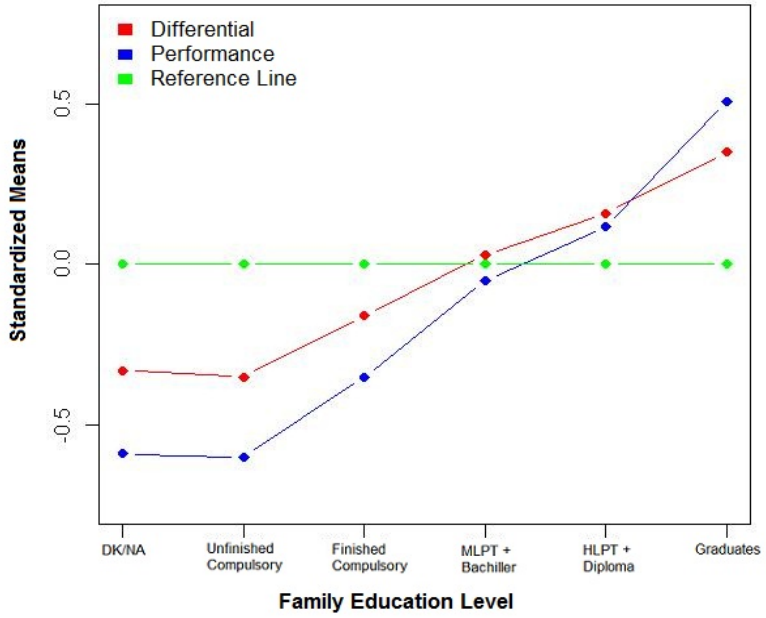
In Figure 1.7 it can be seen that the behavior of the Performance Differential agrees with the comment about social inclusion above: if there were a low social inclusion, the schools would tend to behave uniformly in terms of the education levels of the parents. Therefore, the comparisons in each school would be made between students from families with similar characteristics and, consequently, the average of the performance differentials in each educational level would be close to zero.

By representing the standardized scores of Performance and Performance Differential together in Figure 1.7 it is shown that both variables have a similar behavior. However, the standard deviation of the Performance Differential averages, according to Educational Level of the Family, is approximately 61% of the standard deviation of Performance.

This reduction in the deviation may be explained by the fact that the schools smooth out the differences due to the family environment of the students. Nevertheless, schools surely have a component of educational segregation. As indicated by Hidalgo and García in their work, the

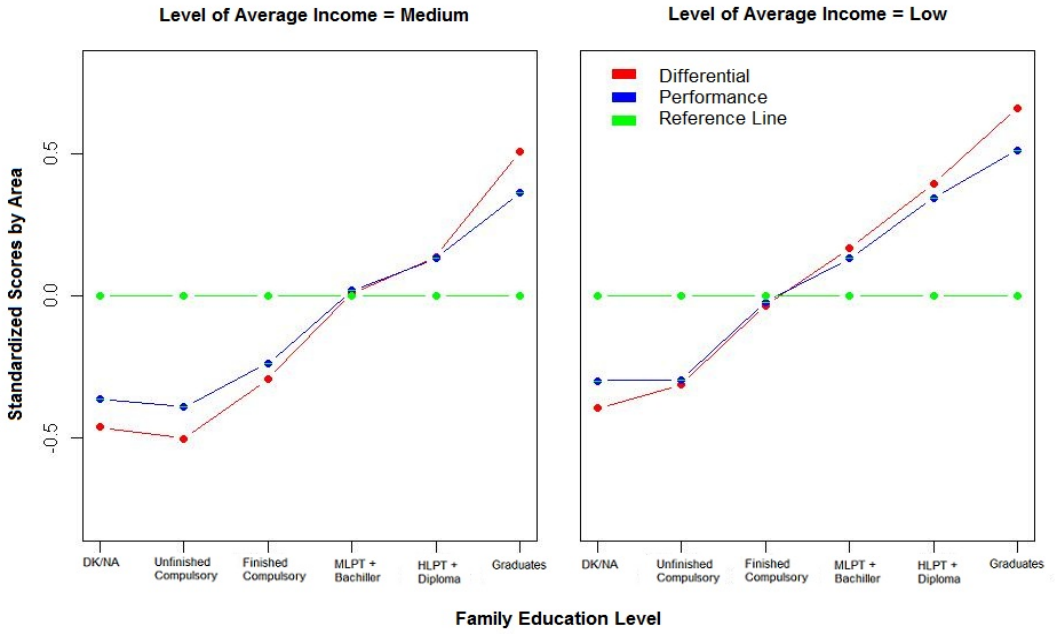
economic level of the area where the school is located is related to the Performance, since the higher the socio-economic environment of the school, the higher will be the average score of the school.

Figure 1.7. Performance and Performance Differential according to Family Educational Level



For that reason, an analogous analysis has been developed by taking into account the effect of the level of average income of the area where the school is located. In Figure 1.8 we can see that the behavior previously observed in Figure 1.7 is maintained in the two analyzed areas. The curves are now closer each other. In this case, the deviation of the Performance Differential becomes 81% of that of the Performance, in both areas.

Figure 1.8. Performance and Performance Differential by area, according to Family Educational Level



To summarize, it seems to confirm that schools tend to moderately smooth out the differences in performance associated with the Family Educational Level. They keep similar scores for the average educational levels, and they bring closer scores for the extreme educational levels.

It should be remarked that in Figure 1.8 it makes no sense to compare the results of both areas, since the standardized scores are computed within each zone.

The analysis could is not performed in the high-income area, since it covers only 5% of the students' sample and families with lower educational levels are barely represented.

The parents' expectations

The maximum academic level that the parents expect their children to reach is a factor that influences the students' performance. For example, in the National Institute for Educational Evaluation reports, in their State System of Education Indicators (INEE, 2009, 2006, 2000) it is shown how "*school performance is influenced by the students' expectations on the level of studies that he/she wants to reach and these, in turn, are influenced by the student's parents' expectations".* Several studies (González-Pienda, 2003; Bazán et al, 2007) have reached similar conclusions.

In Table 1.18 it is shown that the higher the level of studies of the parents, the higher the level of studies they expect their children to reach. For instance, 49% of the parents from the lowest group expect their children to go to university, while in the highest group that percentage is 98%.

Table 1.18. Expectations of the parents according to Family Educational Level

Parents' expectations	DK/NA	Unfinished Compulsory	Finished Compulsory	MLVT + Bachiller	HLVT + Diploma	Graduates	Total
Compulsory	16 %	12 %	7 %	1 %	1 %	0 %	3 %
Post-compulsory	28 %	38 %	31 %	16 %	7 %	2 %	17 %
University	56 %	49 %	62 %	84 %	92 %	98 %	80 %

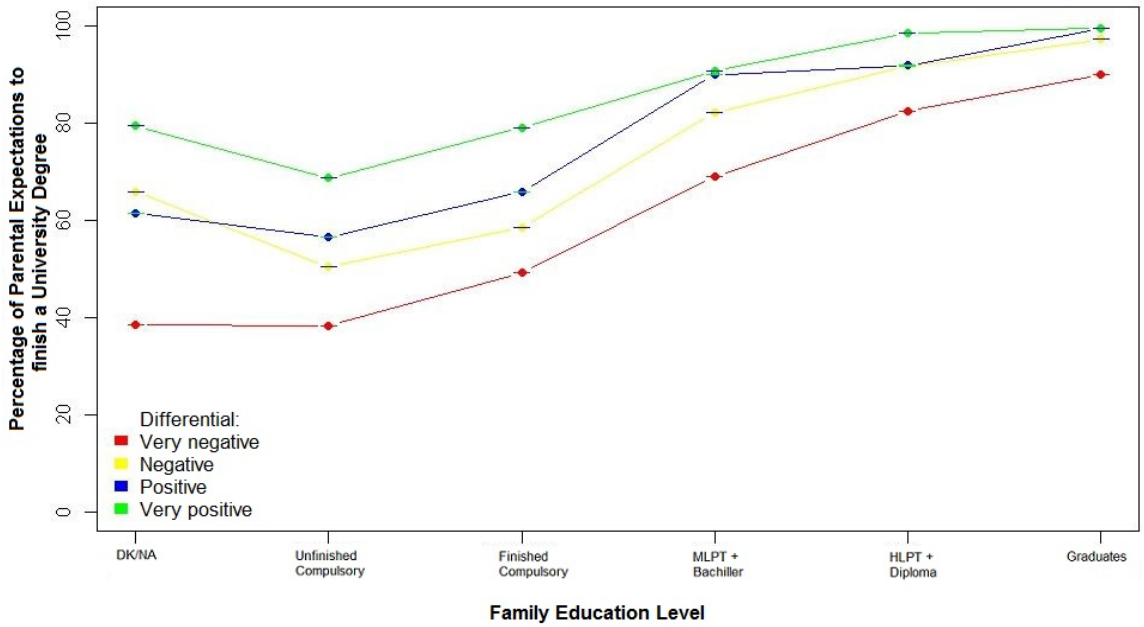
The implications of this sociological trend are clear. We cannot forget that the parents' expectations strongly condition the students' performance and student's expectations: this is the Pygmalion effect.

Therefore, it is interesting to analyze to which extent parental expectations are modified when controlling the Performance Differential. We have used the Performance Differential because it provides a richer and more contextualized information, although the results obtained for Performance are very similar.

The Performance Differential variable is described by four labels in Figure 1.9: "Very Negative" when the Differential is less than the 25th percentile (P25); "Negative" if it is between the 25th and 50th percentiles (P25 and P50); "Positive", between the 50th and 75th percentiles (P50 and P75); and "Very Positive" if it is greater than P75.

The results indicate that the relationship between the Family Educational Level and the parents' expectations changes significantly when taking into account the Performance Differential.

Figure 1.9. Parents' expectations according to Family Educational Level and Performance Differential



The expectations of families with "Unfinished Compulsory" studies are closely related to Performance Differential: the percentage of those families who expect their children to finish a University degree goes from 38% for students with a "Very Negative" Differential to 68% for students with a "Very Positive" Performance Differential.

It is also worth highlighting the changes in parental expectations in the "Finished Compulsory" group. The differences are similar to the previous ones: almost 80% of families whose children have a "Very Positive" Performance Differential expect them to go to University, while in the "Very Negative" category that percentage is less than 50%.

Analogous results are obtained for the "DK / NA" group of Family Educational Level. In this case, the differences are even greater. This situation is interesting since it describes approximately 15% of the sample: 10% of parents do not respond about their academic degree but they express their expectations for their children. And 5% of parents do not respond to any of the two questions.

In families with FPGS or University studies the Performance Differential has little impact on the parents' expectations. The greatest differences are obtained when Performance Differential is "Very Negative". But even in this case the percentage of parents who expect their children to finish a University degree is 90%.

CONCLUSIONS

Apart from the logical reservations that every statistical study should have, it is remarkable the existence of a strong relationship between Family Educational Level and Performance in Language. Note that, for example, while in "Unfinished Compulsory" Group only 2% of students come higher than the 90th Percentile, in the "Graduates" group such percentage is 23%.

These results indicate that in families with a lower educational level there may be a group of students with a potentially high capacity, and which perhaps our Education System is not adequately addressing.

Moreover, the distribution of Performance according to the different Family Educational Levels are overlapped, so the Family Educational Level is not a good predictor by itself of the performance that a student has at any given time. This means that, acting on the rest of the Performance-related factors it will be possible to mitigate the differences due to Family Educational Level.

It has been also analyzed to which extent the other four involved factors (Early Language Training, Early Language Activity, Reading Habits of Parents, Reading Habits of Students) can reduce these differences in performances. It has been clearly seen that all of them are related with Performance, and that their effects accumulate. Furthermore, within each Family Education Level it was shown that, among these factors, the most determinant is Early Language Training. In our view, this reflects the importance of providing a good foundation on language skills in Pre-school education.

The reports in this volume coincide in showing that there are many factors related to Performance, and each of them can provide a small improvement on it. This cumulative effect is especially relevant in families with a low level of education, where the students with lower performance are particularly concentrated. An immediate consequence of this situation is that it would be advisable to implement interventions aimed at children who are growing up in the most disadvantaged family environments.

By analyzing the Performance Differential variable, and taking into account the student performance in relation to their Primary Education school, we can see the moderating role of the school on the starting sociocultural differences such as the Family Educational Level, but also on the other associated factors.

Regarding the age of entry into Primary Education, we have shown that students who began Primary Education at the age of 6 get higher test results than those who had not yet turned 6. However, we also found that although age is a factor that relates to Performance, it is Early Language Training and Family Educational Level which seem to be more important.

Moreover, Primary Education attendance for three or more years is associated with improved Performance. Therefor this is desirable to be fulfilled, especially for students who initially start with clear disadvantages (those that start Primary Education at five years old and come from families with low level of Education).

We have also shown that parental expectations are strongly influenced by Family Educational Level: in the " Unfinished Compulsory" group less than half of parents expect their children to go to University, while in the "Graduate" group almost all parents has this desire; and let us remember that parental expectations influence both the expectations of their children, as well as their performance. This can be a serious obstacle to their development.

As we have already pointed out, one course of action so that students get good early language training may be to increase the length of attendance in Pre-school education. Nevertheless, Education is a multidimensional job, and its development is the responsibility of society as a whole. From the results of this PIRLS 2011 analysis it can be deduced that small actions, such as reading stories to children, playing with letter toys or word games (which do not require specific knowledge and that would correspond to the parents) have a very positive influence on Early Language Training of students. Therefore a systematic and continued intervention of the parents in this regard would be advisable.

In addition, since the child's environment plays an important role in the development of their language skills, the existence of other cultural initiatives, such as storytelling, theater workshops, etc. (whose design and development would correspond to the society as a whole) can help children to get a proper handling of the language, which will be reflected in an improved school performance.

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Chapter 2

Effects of Family Reading Habits on Academic Results in PIRLS 2011

EFFECTS OF FAMILY READING HABITS ON ACADEMIC RESULTS IN PIRLS 2011

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SUMMARY

The literature on education has emphasized the importance of family involvement and its relationship with their children's academic achievements. Family history appears as a statistically significant factor in explaining the academic performance of students, and one of the fundamental mechanisms through which it operates is the influence on the reading habits of students.

Reading habits are, according to this literature, one of the key factors in academic results. Regular readers consistently perform better in most subjects. The reading habits of children can be influenced by their parents mainly in two ways: through the direct training of reading ("reading together") or through the active reading of the parents and through becoming a role model. There are substantial differences in parental practices and modes of interaction with the children, and the relationship between these different family attitudes and the socio-economic situation is unclear.

The precise mechanism by which parental education and the time they spend with their children has an effect on their education has not yet been discussed in the economic literature.

This paper contributes to this literature by providing empirical evidence on the relationship between the reading habits of parents and the academic results for students' reading, using data from the PIRLS 2011 study for Spain.

The results seem to confirm the previous results of Levitt and Dubner (2005) which suggest that parents have a positive effect on the academic performance of the children, more as a role model than for the specific activities they carry out, since the paper suggests that the overall number of books in the home and the number of children's books are valid instruments for reading activities at home. If these tools are used we find that the parents' activity of reading with the children enables a substantial improvement in school performance.

INTRODUCTION

One of the chapters in the famous book by Levitt and Dubner, "Freakonomics" addresses the question of what is it that determines that someone may be a perfect parent ("What makes a perfect parent?", Levitt & Dubner, 2005, chapter 5). Today the question of how to be good parents is fashionable and can be found in many books, television programs and other resources related to this topic. Moreover, many countries have tackled it in their educational policy with mechanisms to try to get parents to increase their involvement in their children's education, both at home and in the educational system.[1]

However, Levitt and Dubner's answer can be a bit daunting for this generalized effort to improve the parental involvement in the education of their children. According to these authors, the empirical evidence shows that is not so much what parents do that matters, but what parents represent for their children as role models. In this second aspect, what they are like as parents is much more important than their attitudes, and in turn their educational and socio-cultural background are crucial.

This paper uses data from the international PIRLS 2011 study corresponding to the survey for parents of students, and a sample of countries in PIRLS 2006 for comparison (Germany, Austria, Denmark, Iceland, Spain and Sweden). In particular we look at the effects of the reading that parents do with their children and their own reading activity on the academic performance of the children.

According to education and developmental psychology, the involvement of parents in the education of children can operate through two channels. On the one hand parents can influence their children directly through direct activities complementary to their schooling. The activity of reading is one of them and is the one we analyze in this paper. On the other hand parents can encourage their children's school performance simply by acting as a role model for them. Seeing parents interested and active in activities that also take place at school, in particular seeing parents as active readers, produces an effect of emulation and imitation in their children which can have a positive impact on school performance.

The contribution of this paper is to use the information provided by the PIRLS 2011 study to provide new evidence on the impact of reading activities on school performance. We take into account two types of reading activities. Firstly, reading activity pertaining to the parents, and secondly, the reading activity of the children.

One problem with this type of analysis is the possible endogeneity of the reading activities with school performance. The greater involvement of parents can have an impact on the school performance of their children, but can also be a reaction to either low or high school performance. Another problem that can lead to bias in the estimation of the effects is the measurement error in the variables which measure family involvement. In this paper we

[1] For an example see the 2001 Act of "No Child Left Behind" in the United States or the 2003 Green Paper "Every Child Matters" in the UK.

attempt to correct both problems using variables related to educational resources that exist at home, in particular using the total number of books in general and of children's books as instruments for the reading variables, and using an instrumental variables estimation.

The main results of the paper show that there is a significant and positive effect of reading activities on school performance, and that this effect is robust when considering the educational background of parents. On average, a student who has parents who are involved in reading can move up by about 10 percentage points with respect to the percentile occupied by a student with parents who don't read. However, when making corrections for possible problems of endogeneity and measurement errors in the variables, only the effect of direct reading with students is significant. These results are especially important for the Spanish education system because the percentage of parents who are readers is quite a lot smaller than in our neighbouring countries, even when taking into account the different levels of parental education, so that there is a clear implication for educational policy in the sense of encouraging a greater level of reading activity in the population and a greater involvement of support for reading at home.

The paper begins with a review of the previous related literature and continues with a description of the data used. It goes on to describe the principal patterns observed in the variables of interest, and a comparison is made between the levels of Spanish parents' reading with those of the parents in the comparison sample included. The next two sections present the econometric specification used and the results of the estimation. The final section sets out the conclusions of the paper.

PREVIOUS LITERATURE

The analysis of the factors influencing the academic performance in the different stages of education has acquired an increasingly prominent place in the economic literature. Although the analysis of performance and learning factors in the educational system has a long tradition in the fields of sociology, developmental psychology or pedagogy and didactics, it has only recently attracted the interest of economic analysis. Applied economic analysis has the appropriate statistical techniques for analyzing the causality of different factors affecting academic performance in the education system since, from the econometric point of view, when analyzing the relationship of academic performance of students with different factors which may explain the performance, there are severe problems of sample selection, endogeneity of factors assumed to be exogenous, measurement errors and other statistical problems. So the main contribution that the economic literature might bring to educational performance analysis is a correct identification of the causal effects of different potential explanatory factors.

From a theoretical standpoint academic performance has been thought of as a production function, which takes into account various inputs that are transformed into the output measured from standard test results and which are internationally comparable. The inputs

considered have been varied, including both aspects relating to the schools, the teachers, the organization and management of schools, the school atmosphere, and many other factors that can influence the performance of students, as well as home-related aspects, such as the time commitment from parents, their educational and socio-economic background, the resources relating to education such as books, a place for study, possession of computers and other complementary elements, and many other aspects that can enhance learning. In our case we will focus on the review of some studies that have looked at this second source of inputs for academic performance, ie: aspects relating to the student's family.

The allocation of family time to the children has been addressed in several studies- for an overview see Guryuan et al (2008). These authors studied the relationship between time spent with children, both in cognitive activities such as reading together or help with homework, as well as in non-cognitive activities attending to the basic needs of the children, and the education and socio-economic situation of the parents. One of the results that stands out is that the more educated parents spend more time with their children. Mothers with a higher education, for example, spend 4.5 hours per week more than those mothers with only a high school qualification or less. The time spent reading with the children isn't studied specifically, but Guryuan et. al. find that their results are robust with respect to the different activities of the parents with the children, and are valid for both educational, leisure or assistance activities.

With respect to inputs that exist in the home and that can positively affect the academic performance of students, Todd and Wolpin (2007) find that there are high and statistically significant returns of current and past investments to these inputs. In this case the domestic inputs are an aggregate of everything the students find at home, for example the direct relationship with parents from an emotional and assistance standpoint, parental involvement, the organization of the home environment, learning materials and other positive stimuli, etc.

Martínez García and Córdoba (2013) use data from the PIRLS 2011 study which correspond to the Spanish sample to study gender differences in reading. They find differences in reading performance between boys and girls but these are small, and they attribute this limited difference to the fact that the educational background and occupation of the mothers have a larger effect on the performance of girls than for boys. They also emphasize the relationship between the social conditions of the family and the educational practices related to the stimulus of reading.

One interesting work is that of Cunha and Heckman (2008) because they try to take into account the distinction between cognitive and noncognitive skills of parents. To do this they build an aggregate of inputs that the parents provide, constructing a proxy for the direct and complementary investments in the home that can positively stimulate student learning. One of their results shows that parental inputs are more effective for the non-cognitive skills than for cognitive skills. They don't specifically mention the reading activities of parents, but they find that cognitive activities, which may be associated more closely with reading, are more important in the initial stages of learning, whereas the non-cognitive ones become important in later stages.

One aspect that is related to our approach in this article is the mechanism by which parental involvement can be translated into a better learning process by the students. This topic has been studied mainly by other disciplines, in particular didactics or developmental psychology. For example Hoover-Dempsey and Sandler (1995, 1997) propose three mechanisms by which parents can influence their children's academic performance if they increase their involvement. The first mechanism is the role model. Children emulate and imitate the behaviors of the parents, especially at early ages. If parents dedicate time, effort and interest in school activities, they can influence the academic results of their children. The second mechanism can be defined as reinforcement of the student's own dedication. If parents are concerned, pay attention and reward behaviors related to school success, the children will make more effort in activities that improve their academic performance, if they are seen to be motivated and value these stimuli. The third mechanism would be direct instruction. If parents read and correct the children in the reading activity, for example, they will complement the school activity and improve the student's performance.

Finally, there has been some interest in the literature in analyzing whether the returns obtained from family involvement vary with the socio-economic status of the family. Although the evidence from these studies is inconclusive, it has been established that there is a positive correlation between the socioeconomic status of the family and the school performance of the family involvement (McNeal, 2001), and for the United States there is also a correlation with ethnic groups and economically advantaged social groups (McNeal, 1999 and Desimone, 1999). These studies do not take into account the possible endogeneity of family involvement with the academic performance of students.

DESCRIPTION OF THE DATA

This paper is based on data from the PIRLS 2011 study for Spain. For comparison purposes data from the PIRLS 2006 study are also used for the following countries: Austria, Denmark, Germany, Iceland, Sweden and Spain. The choice of countries was based on allowing a comparison with the results that will be observed in Spain, choosing for those three Scandinavian countries, where family involvement in education is quite high, and two German-speaking countries where reading habits, both personal and with the children, are quite accentuated.

The variables used are as follows:

Reading Score: PIRLS result (*score*) which gives a grade for the reading test. The PIRLS study uses the method of plausible values, so that five reading values are displayed for each student. For a correct estimate one has to use the estimation procedure described in PIRLS (2008)[2]. The PVs in PIRLS 2001 were scaled to get an average of 500 and a standard deviation of 100, and

[2] For the estimation the PV comand ofStata is used, see Lauzon (2004), which allows the correct use of all sample weights specified by the PIRLS manual.

thereafter the scores were adjusted to these scales. In our case we scale the PVs so that they reflect the percentile that the student occupies within the distribution of plausible values for each country, something which allows a better interpretation of the values of the estimated coefficients and a better comparison between countries.

Gender of the respondents of the survey: The questionnaire indicates whether the mother, father, both, or a third person answered the family survey. We eliminated all cases corresponding to the latter option, which are less than 1% of the total, and with the other options we constructed *dummies* referring to the gender of the parent. This variable refers to an aspect of gender for each case, but should be viewed with caution since in many cases the person answering the survey answers for both parents.

Direct reading of parents: A question from the parents' questionnaire where they are asked how many hours they devote to reading per week. The variable is presented in four levels (less than one hour, 1-5 hours, 6-10 hours, more than 10 hours). Based on this question a dummy variable is constructed with a value equal to 0 for the two lowest levels of reading, and equal to 1 for the highest values of reading, in order to facilitate the interpretation of the coefficients and to make it comparable with the reading variable with children, that has only 3 levels.

Reading with the children: This question asks whether the mother or father reads with the children. The variable is presented in three levels (very often, sometimes and never). A dummy variable is constructed which is equal to 0 if the parent reads little or not at all with the children (never or sometimes), and equal to 1 if the parent reads with the children a lot (very often).

Number of books in the home: It asks about the total number of books at home, with five different levels.

Number of children's books in the home: It asks about the number of children's books at home, with five different levels.

Educational level of the father and mother: It asks about the educational level reached, with the following levels: no studies, compulsory secondary, non-compulsory secondary, level 1 vocational training, level 2 vocational training, diploma and degree or equivalent. We construct dummy variables for fathers and mothers.

In the next section we present a description of the variables used.

Table 2.1. Parents answering the survey

Country	Only Father	Only Mother	Both	None	Total
Austria	506	3529	596	68	4699
Denmark	538	2626	487	20	3671
Germany	526	4798	1327	70	6721
Iceland	269	2211	246	4	2730
Spain	407	1660	362	16	2445
Sweden	677	2846	501	13	4037

Spain 2011	Only Father	Only Mother	Both	None	Total
	1234	5225	1206	88	7753

ACTIVE READING, ROLE MODEL AND EDUCATIONAL BACKGROUND OF THE PARENTS

In this section we present descriptive tables of the variables used in this paper.

Table 2.1 shows the responses given to the family survey in PIRLS 2006 for the selected countries and in 2011 only for Spain. In the survey, information is available as to whether only one of the parents answered, or both, or neither. Based on this information a variable will be constructed to present differentiated effects for fathers and mothers. As can be seen in the table, most of the surveys are answered only by mothers or both parents, and to a lesser extent by the fathers only.

Table 2.2 presents information on the reading habits of children with parents in selected countries and in Spain in 2011, broken down for different educational levels of the parents. In this table, only responses where just the father or the mother of the student answered are used, and the cases where both have answered are not used. For the data on fathers and mothers the responses are broken down according to the educational level stated by the parent. For all the levels of education, and as much for fathers as for mothers, we can see that for Spanish parents the reading time with their children is less than for the selected countries. In this regard the percentages of reading observed for the Scandinavian countries stand out, especially in Iceland where, even for low educational levels of parents, the levels of reading time with children is quite notable.

Firstly, it can be seen that the level of reading with children is generally lower in the Spanish data than in the countries that have been used for comparison. Thus using the data of the mothers, who are the ones who mainly respond to the family survey, both in PIRLS 2006 and in PIRLS 2011 we see that 80.8% in Iceland and 73.4% in Sweden read very often to their children, while this figure is reduced to 47.57% in 2006 and 47.99% in 2011 for Spain. While the reading level clearly increases with the educational level of the parents, we see that this increase does not mitigate the difference for the higher levels of education if we compare Spain with the rest of the countries included for comparison. Thus 72.72% of mothers with a higher university degree read very often to their children according to PIRLS 2006, and 68.18% according to PIRLS 2011, while by using PIRLS 2006 these percentages increase to 92.73% for Germany and 92.47% for Iceland.

Table 2.3 presents a similar table but for the reading that the parents themselves do, showing how many hours per week the parents devote to reading in the different selected countries and in Spain.

Consistent with data from other sources, the PIRLS study data show that the reading level of the Spanish population is lower when compared to neighboring countries. So overall 13.43% of mothers responding to the survey state that they read more than 10 hours a week in PIRLS 2006, and 16% in PIRLS 2011, while the PIRLS 2006 data these percentages are 20.35% for Sweden and 20.02% for Germany.

As seems logical, the reading time increases with educational level. In this case the differences with the countries included for comparison are smaller, though significant differences remain for all educational levels. So if we look at mothers with a higher university degree we see in the 2006 data that a 40.71% of Swedish mothers state that they read more than 10 hours per week, and 40% of German mothers, while for Spanish mothers with a higher university degree 30.9% state that they read over 10 hours in PIRLS 2006, and 34.7% in PIRLS 2011.

Table 2.2. Parents reading to kids (2006)

Mother		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	Often	20	36,23	25,68	53,85	25,77	30	24,04
	Sometimes	40	57,97	58,11	38,46	56,7	60	68,3
	Never	40	5,8	16,22	7,69	17,53	10	7,66
Compulsory Secondary	Often	38,21	50,33	56,19	69,8	31,86	45,14	34,93
	Sometimes	55,19	48,34	39,7	29,31	57,08	51,43	57,28
	Never	6,6	1,32	4,11	0,89	11,06	3,43	7,79
Non-compulsory Secondary	Often	58,23	71,29	75,84	77,82	49,15	65,78	50,3
	Sometimes	37,61	27,76	22,18	21,64	44,79	32,56	45,69
	Never	4,16	0,95	1,98	0,55	6,05	1,66	4,01
Vocational Training I	Often	75,95	64,1	--	76,11	--	73,78	50,87
	Sometimes	24,9	33,97	--	22,78	--	25,44	47,04
	Never	1,15	1,92	--	1,11	--	0,78	2,09
Vocational Training II	Often	72,96	74,31	--	84,35	56,21	78,46	55,38
	Sometimes	24,1	24,39	13,95	18,37	39,87	21,28	40,32
	Never	2,93	1,3	1,7	0,68	3,92	0,26	4,3
College Diploma	Often	69,05	81,4	87,1	89,64	64,74	86,21	64,62
	Sometimes	23,81	17,61	11,99	10,05	34,1	12,98	33,08
	Never	7,14	1	0,9	0,31	1,16	0,81	2,31
University Degree	Often	89,71	88,7	92,73	92,47	72,12	91,7	68,18
	Sometimes	9,05	10,96	7,27	7,53	25,22	7,51	30,21
	Never	1,23	0,33	0	0	2,65	0,79	1,61
Total	Often	61,25	72,47	68,1	80,8	47,57	73,4	47,99
	Sometimes	34,78	2,27	28,96	18,61	45,41	25,08	47,09
	Never	3,98	1,27	2,94	0,59	7,02	1,52	4,92

Table 2.3. Parents reading to kids (2006)

Father		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	Often	40	30	10	33,33	23,08	25	16,05
	Sometimes	20	65	70	66,67	69,23	50	67,9
	Never	40	5	20	0	7,69	25	16,05
Compulsory Secondary	Often	26,8	24,44	26,8	74,19	18,82	48,28	19,55
	Sometimes	60,13	68,89	60,13	22,58	69,41	43,1	67,73
	Never	13,07	6,67	13,07	3,23	11,76	8,62	12,73
Non-compulsory Secondary	Often	33,33	51,32	44,23	56,16	30,84	49,72	29,73
	Sometimes	55,22	44,74	45,51	41,1	57,94	47,46	58,45
	Never	11,45	3,95	10,26	2,74	11,21	2,82	11,82
Vocational Training I	Often	57,14	55,17	--	57,14	--	55,83	30,77
	Sometimes	42,86	34,48	--	38,29	--	42,5	59,34
	Never	0	10,34	--	3,57	--	1,67	9,89
Vocational Training II	Often	40	64,84	66,67	84	25,64	62,16	29,41
	Sometimes	52,73	34,07	33,33	16	64,1	35,14	54,9
	Never	7,27	1,1	0	0	10,26	2,7	15,69
College Diploma	Often	45,75	61,68	53,73	84,75	52,27	76,25	42,76
	Sometimes	56,25	37,38	38,81	15,25	47,73	22,5	53,79
	Never	0	0,93	7,46	0	0	1,25	3,45
University Degree	Often	76,19	74,77	76,19	74,36	56,82	80,21	53,04
	Sometimes	14,29	24,32	14,29	25,64	36,36	17,71	42,61
	Never	9,52	0,9	9,52	0	6,82	2,08	4,35
Total	Often	37,37	57,25	41,01	70,04	35,79	58,63	33,28
	Sometimes	51,31	39,36	48,74	28,46	55,08	38,1	51,12
	Never	11,31	3,39	10,25	1,5	9,14	3,27	9,6

Table 2.4. Parents reading themselves

Mother		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	< 1 hour week	41,67	30,43	24	7,69	42,86	33,33	37,47
	1-5 hours	41,67	44,93	53,33	53,85	40,82	22,22	45,26
	6-10 hours	16,67	20,29	14,67	30,77	11,22	33,33	11,16
	> 10 hours	0	4,35	8	7,69	5,1	11,11	6,11
Compulsory Secondary	< 1 hour week	28,57	17,76	13,78	12,75	24,2	18,02	22,8
	1-5 hours	51,61	54,61	46,71	52,57	50,53	47,67	50,13
	6-10 hours	14,29	23,68	26,61	25,28	18,47	25	18,52
	> 10 hours	5,53	3,95	12,9	9,4	6,79	9,3	8,55
Non-compulsory Secondary	< 1 hour week	10,19	9,12	5,25	5,66	9,57	9,87	11,75
	1-5 hours	50,6	56,29	35,82	46,53	48,8	50,17	49,4
	6-10 hours	26,61	25,16	37,53	34,49	27,75	26,25	24,53
	> 10 hours	12,6	9,43	21,39	13,32	13,88	13,71	14,31
Vocational Training I	< 1 hour week	6,82	9,62	--	9,39	--	5,3	10,92
	1-5 hours	41,67	58,33	--	48,07	--	43,61	47,54
	6-10 hours	32,58	24,36	--	31,49	--	33,01	26,41
	> 10 hours	18,94	7,69	--	11,05	--	18,07	15,14
Vocational Training II	< 1 hour week	7,52	6,32	2,39	2,74	7,14	5,4	5,91
	1-5 hours	42,81	55,27	32,08	45,89	48,05	35,99	40,32
	6-10 hours	29,08	29,17	36,52	30,82	32,82	37,02	29,03
	> 10 hours	20,59	9,24	29,01	20,55	12,99	21,59	24,73
College Diploma	< 1 hour week	0	5,29	1,36	2,36	3,43	2,43	4,69
	1-5 hours	35,59	46,61	20,91	31,76	44,57	32,25	39,53
	6-10 hours	43,9	35,37	39,32	37,11	37,14	37,12	30,94
	> 10 hours	19,51	12,73	38,41	28,77	14,86	28,19	24,84
University Degree	< 1 hour week	0,41	1	0	4,3	2,65	2,77	4,39
	1-5 hours	21,81	30,33	21,82	19,89	30,97	18,97	28,26
	6-10 hours	43,62	43,67	48,18	38,17	36,28	37,55	32,65
	> 10 hours	34,16	25	40	37,63	30,09	40,71	34,7
Total	< 1 hour week	10,45	8,04	8,66	6,21	15,06	7,61	15,93
	1-5 hours	46,99	52,28	39,37	41,18	46,1	39,79	44,3
	6-10 hours	27,69	39,8	31,95	33,29	25,41	32,25	23,17
	> 10 hours	14,86	10,88	20,02	19,32	13,43	20,35	16

Table 2.3. Parents reading themselves

Father		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	< 1 hour week	40	15	20	33,33	15,38	66,67	40,24
	1-5 hours	40	75	40	33,33	76,92	33,33	34,15
	6-10 hours	20	10	30	33,33	7,69	0	12,2
	> 10 hours	0	0	10	0	0	0	13,41
Compulsory Secondary	< 1 hour week	12,2	15,56	17,65	12,12	23,08	20,69	19,09
	1-5 hours	41,22	53,33	45,1	60,61	54,95	37,93	49,55
	6-10 hours	31,71	20	24,18	18,18	18,68	36,21	19,09
	> 10 hours	4,88	11,11	13,07	9,09	3,3	5,17	12,27
Non-compulsory Secondary	< 1 hour week	8,58	11,84	7,01	6,85	9,01	11,11	14,14
	1-5 hours	48,84	47,37	43,95	54,79	46,85	50	45,45
	6-10 hours	25,74	31,58	29,94	28,77	30,63	24,44	26,6
	> 10 hours	16,83	9,21	19,11	9,59	13,51	14,44	13,8
Vocational Training I	< 1 hour week	0	0	--	7,14	--	5	6,74
	1-5 hours	71,43	55,17	--	42,86	--	48,33	41,57
	6-10 hours	14,29	31,03	--	42,86	--	30,83	32,58
	> 10 hours	14,29	13,79	--	7,14	--	15,83	19,1
Vocational Training II	< 1 hour week	9,09	11,7	0	0	7,5	7,89	10
	1-5 hours	47,27	53,19	31,58	32	55	39,47	38
	6-10 hours	30,91	28,72	42,11	40	27,5	36,84	30
	> 10 hours	12,73	6,38	26,32	28	10	15,79	22
College Diploma	< 1 hour week	5,88	3,67	0	1,69	2,27	1,25	5,41
	1-5 hours	47,06	45,87	33,82	30,51	31,82	45	35,14
	6-10 hours	23,53	36,7	41,18	42,37	40,91	32,5	36,49
	> 10 hours	23,53	13,76	25	24,42	25	21,25	22,97
University Degree	< 1 hour week	3,28	6,25	0	0	5,62	1,04	5,26
	1-5 hours	27,87	30,36	14,29	28,21	26,97	30,21	25,44
	6-10 hours	34,43	43,75	23,81	41,03	37,08	30,54	27,19
	> 10 hours	34,43	19,64	61,9	30,77	30,34	30,21	42,11
Total	< 1 hour week	8,8	8,38	9,21	5,22	11,3	8,31	14,02
	1-5 hours	46,2	48,6	41,07	42,16	44,47	44,21	39,5
	6-10 hours	27	31,66	30,71	34,33	29,24	31,01	25,98
	> 10 hours	18	11,36	19	18,28	14,99	16,47	20,5

Finally we present similar tables for the number of books in general and for children's books as stated by the parents in the family survey in the PIRLS study. These two variables allow us to obtain information similar to the two variables used above, ie: parents' own reading and parents reading to their children. One difference between the number of books and the variables used previously is that the amount of books that are available at home can be considered as a prior investment for the activity of reading itself. Therefore, in the subsequent statistical analysis these two variables will be used as an exogenous factor related to the family reading activity for themselves and with the children.

Table 2.4 shows the number of books that have families at home, for the different selected countries and for Spain PIRLS 2011. The pattern is similar to the reading variables, the Scandinavian countries showing overall a greater possession of books at home. Both in 2006 and 2011 book ownership is lower in Spain. If we look for surveys where only the mother responds, we see that the families that have more than 200 books represent 25.54% in 2006

and 19.64% in 2011, compared to 43.47% in Sweden and 37.4% in Iceland for 2006. If we break it down by educational level we see this pattern is maintained, although in this case the German-speaking countries stand out as the cases where families have more books at home, especially Germany for parents with higher education. Looking again at the surveys answered only by the mother, for mothers with a higher university degree we see that in Germany 96.36% have more than 200 books, compared to 66.52% in 2006 for Spain and 54.58% in 2011.

As regards children's books the data are presented in Table 2.5. The observed pattern is similar to that of the data of books in general in the home. For example for the surveys submitted only by mothers, in 2006 29.52% of the total stated that they possess more than 100 children's books in Sweden, and 27.03% in Iceland, while for Spain this percentage drops to 12.67% in 2006 and 10.56 % in 2011. If we look at education levels of the mothers we observe that 54.51% of Swedish households with mothers with a higher university degree have more than 100 children's books, or 56.36% of German households, while for Spain these figures fall to 38.5% in 2006 and 27.31% in 2011.

In general then, we can see that the Spanish families' resources in terms of books are lower than in the other countries we have selected for comparison, and this difference is not mitigated if the educational level of the parents is taken into account.

Table 2.4. Books at home

Mother		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	0-10	41,67	31,43	23,68	7,69	22,45	11,11	23,08
	11-25	25	22,86	19,74	15,38	38,78	22,22	35,97
	26-100	16,67	27,14	40,79	53,85	24,49	55,56	29,52
	101-200	16,67	11,43	11,84	7,69	11,22	0	6,86
	More than 200	0	7,14	3,95	15,38	3,06	11,11	4,57
Compulsory Secondary	0-10	22,54	21,71	7,82	3,81	6,42	7,56	13,6
	11-25	26,29	23,68	17,78	8,52	26,77	19,19	27,94
	26-100	31,46	33,55	43,37	39,69	46,04	41,86	40,8
	101-200	11,27	13,16	17,21	27,35	12,21	19,19	11,77
	More than 200	8,45	7,89	14,82	20,63	8,57	12,21	5,89
Non-compulsory Secondary	0-10	6,59	6,6	1,2	2,01	3,57	3,69	5,15
	11-25	15,26	12,89	6,14	8,41	11,67	7,55	15,62
	26-100	42,03	38,05	30,51	37,66	36,19	35,07	43,83
	101-200	17,72	19,18	24,75	25,05	23,33	26,17	18,83
	More than 200	18,41	23,27	37,41	26,87	25,24	27,52	16,55
Vocational Training I	0-10	1,91	10,26	--	0	--	1,57	5,88
	11-25	6,49	6,41	--	10,56	--	5,5	11,07
	26-100	38,17	45,59	--	37,22	--	29,67	47,75
	101-200	20,99	22,44	--	22,78	--	25,34	20,42
	More than 200	32,44	17,31	--	29,44	--	37,92	14,88
Vocational Training II	0-10	1,96	5,34	1,02	0	0,65	0,51	2,69
	11-25	5,88	9,71	1,71	3,4	7,74	2,57	12,9
	26-100	21,9	35,6	14,68	30,61	42,58	22,11	39,78
	101-200	23,53	20,06	20,82	28,57	21,94	20,31	26,34
	More than 200	46,73	29,29	61,77	37,41	27,1	54,5	18,28
College Diploma	0-10	4,76	2,48	0,23	0,47	0	0,61	1,84
	11-25	7,14	4,64	2,05	2,36	2,29	1,21	4,61
	26-100	28,57	25,66	9,55	21,86	27,43	11,54	30,88
	101-200	14,29	26,82	15,23	24,69	32	20,65	28,11
	More than 200	45,24	40,4	72,95	50,63	38,29	65,99	34,56
University Degree	0-10	0,41	0,33	0	0	0	0	0,87
	11-25	0,41	0	0	0	1,32	0,39	4,05
	26-100	10,66	12,67	0	11,29	10,57	5,88	20,23
	101-200	17,62	16,33	3,64	14,52	21,59	10,2	20,38
	More than 200	70,9	70,67	96,36	74,19	66,52	83,53	54,48
Total	0-10	6,78	7,08	4,38	1,54	4,84	2,62	8,65
	11-25	13,33	9,91	10,48	5,76	15,74	6,21	18,04
	26-100	36,71	31,76	32,8	30,82	34,44	26,38	36,24
	101-200	17,93	20,09	19,42	24,47	19,43	21,42	17,43
	More than 200	25,25	31,15	32,92	37,4	25,54	43,37	19,64

Table 2.4. Books at home

Father		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	0-10	40	20	40	0	15,58	33,33	27,71
	11-25	20	25	10	66,67	7,69	66,67	37,35
	26-100	20	25	50	33,33	69,23	0	28,92
	101-200	0	10	0	0	7,69	0	3,61
	More than 200	20	20	0	0	0	0	2,41
Compulsory Secondary	0-10	25	22,22	12,34	0	5,49	12,28	16,89
	11-25	25	24,44	25,97	6,06	27,47	17,54	20
	26-100	35	33,33	34,42	39,39	49,45	38,6	44,44
	101-200	12,5	13,33	15,58	30,3	12,09	15,79	13,78
	More than 200	2,5	6,67	11,69	24,24	5,49	15,79	4,89
Non-compulsory Secondary	0-10	7,12	9,21	5,1	4,11	2,7	6,67	8,45
	11-25	19,66	17,11	12,74	10,96	18,92	12,22	21,96
	26-100	39,32	30,26	26,11	27,4	30,63	36,67	36,15
	101-200	16,27	22,37	24,84	27,4	24,32	24,44	17,57
	More than 200	17,63	21,05	31,21	30,14	23,42	20	15,88
Vocational Training I	0-10	0	13,79	--	0	--	2,5	7,61
	11-25	33,33	10,34	--	3,57	--	7,5	13,04
	26-100	50	24,14	--	35,71	--	33,33	43,48
	101-200	0	17,24	--	25	--	28,33	26,09
	More than 200	16,67	34,48	--	35,71	--	28,33	9,78
Vocational Training II	0-10	9,09	5,32	0	4	7,69	2,63	4
	11-25	14,55	12,77	7,89	28	10,26	6,58	10
	26-100	34,55	34,04	13,16	0	35,9	34,21	38
	101-200	18,1	12,77	18,42	24	17,95	13,16	24
	More than 200	23,64	35,11	60,53	44	28,21	43,42	24
College Diploma	0-10	11,11	3,67	0	0	0	1,25	1,36
	11-25	5,56	6,42	2,9	0	4,55	5	4,08
	26-100	22,22	34,85	10,14	15,25	25	18,75	26,53
	101-200	27,78	25,69	23,19	25,42	22,73	18,75	29,93
	More than 200	33,33	29,36	63,77	59,32	47,73	56,25	38,1
University Degree	0-10	1,67	2,68	0	0	0	0	0,86
	11-25	3,33	4,46	0	0	1,14	1,04	4,31
	26-100	16,67	13,39	0	10,26	13,64	12,5	13,36
	101-200	16,67	16,96	9,52	5,13	27,27	15,62	25,86
	More than 200	61,67	62,5	90,48	84,62	57,95	70,83	55,6
Total	0-10	9,18	9,57	7,66	1,5	4,44	4,93	9,29
	11-25	17,55	12,01	15,9	5,24	14,32	9,25	16,53
	26-100	34,29	27,58	26,25	24,34	32,59	29,85	31,99
	101-200	16,12	17,82	18,01	23,6	20	20,9	19,49
	More than 200	22,86	33,02	32,12	45,32	28,64	35,07	22,7

Table 2.5. Children books at home 2006

Mother		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	0-10	58,33	25,71	34,21	0	37,37	20	28,87
	11-25	25	24,29	31,58	23,08	31,31	30	34,23
	26-50	8,33	24,29	19,74	15,38	20,2	20	23,92
	51-100	8,33	15,71	10,53	61,54	9,09	20	10,31
	More than 100	0	10	3,95	0	2,02	10	2,68
Compulsory Secondary	0-10	22,64	11,92	8,04	1,35	14,86	10,34	16,64
	11-25	27,83	17,22	23,62	7,17	30,79	21,26	24,48
	26-50	32,08	29,8	37,94	32,51	37,58	30,46	35,26
	51-100	12,26	27,81	22,49	38,34	11,68	26,44	15,4
	More than 100	5,19	13,25	7,91	20,63	5,1	11,49	4,22
Non-compulsory Secondary	0-10	5,25	3,46	1,83	0,55	4,3	4,5	6,21
	11-25	19,58	11,64	9,98	4,01	21,96	12,33	22,25
	26-50	37,31	26,1	31,65	29,33	35,56	29,33	37,87
	51-100	26,2	33,65	33,29	42,99	27,45	33,17	24,44
	More than 100	11,66	25,16	23,25	23,13	10,74	20,67	8,23
Vocational Training I	0-10	2,66	3,82	--	0	--	1,57	5,17
	11-25	10,27	14,65	--	7,18	--	10,39	18,62
	26-50	32,7	34,39	--	38,67	--	24,9	38,28
	51-100	34,98	29,94	--	38,12	--	36,86	27,93
	More than 100	19,39	17,2	--	16,02	--	26,27	10
Vocational Training II	0-10	1,97	2,27	1,7	0,68	1,94	1,29	4,81
	11-25	7,87	9,56	4,76	4,76	18,71	7,2	13,9
	26-50	24,59	27,55	20,41	25,85	42,58	21,85	43,85
	51-100	30,49	38,57	34,69	41,5	25,16	35,48	27,27
	More than 100	35,08	22,04	38,44	27,21	11,61	34,19	10,16
College Diploma	0-10	4,76	1,16	0,45	0	1,71	1,21	2,14
	11-25	23,81	6,94	3,17	2,36	9,71	4,24	9,65
	26-50	23,81	22,48	19,91	19,5	28	16,36	30,78
	51-100	19,05	36,03	32,58	44,81	46,86	34,75	38,74
	More than 100	28,57	33,39	43,89	33,33	13,71	43,43	18,68
University Degree	0-10	0	0,66	0	0	0,88	0	1,59
	11-25	4,1	3,99	0	1,63	2,65	2,35	7,37
	26-50	11,48	15,95	7,27	14,67	18,58	10,98	25,72
	51-100	35,25	33,22	36,36	39,13	39,38	32,16	38,01
	More than 100	49,18	46,18	56,36	44,57	38,5	54,51	27,31
Total	0-10	5,97	4,28	4,82	0,5	9,27	3,43	10,75
	11-25	17,4	10,47	15,35	4,45	21,27	9,83	21,35
	26-50	33,33	25,92	32,04	26,26	32,48	23,82	32,98
	51-100	26,82	33,41	28,22	41,75	24,3	33,4	24,37
	More than 100	16,48	25,92	19,56	27,03	12,67	29,52	10,56

Table 2.5. Children books at home 2006

Father		Austria	Denmark	Germany	Iceland	Spain	Sweden	Spain 2011
Unfinished Primary	0-10	50	45	30	0	30,77	50	33,33
	11-25	33,33	20	50	33,33	53,85	0	41,67
	26-50	0	10	10	33,33	7,69	50	15,48
	51-100	0	5	10	33,33	0	0	8,33
	More than 100	16,67	20	0	0	7,69	0	1,19
Compulsory Secondary	0-10	60	33,33	15,48	3,03	13,19	13,79	18,5
	11-25	15	17,78	33,55	9,09	42,86	18,97	37
	26-50	17,5	33,33	32,26	33,33	35,16	32,76	30,84
	51-100	7,5	11,11	13,55	24,24	7,69	17,24	12,33
	More than 100	0	4,44	5,16	30,3	1,1	17,24	1,32
Non-compulsory Secondary	0-10	13,22	13,16	8,33	2,74	12,73	8,38	11,74
	11-25	28,47	14,47	22,44	15,07	30	21,79	28,86
	26-50	33,9	32,89	26,92	35,62	30,91	35,2	34,9
	51-100	15,93	32,89	28,21	31,51	20	25,7	20,81
	More than 100	8,47	6,58	14,1	15,07	6,36	8,94	3,69
Vocational Training I	0-10	16,67	3,45	--	0	--	4,17	6,52
	11-25	50	13,79	--	7,14	--	18,33	27,17
	26-50	16,67	31,03	--	46,43	--	33,33	40,22
	51-100	16,67	37,93	--	39,29	--	30	19,57
	More than 100	0	13,79	--	7,14	--	14,17	6,52
Vocational Training II	0-10	5,45	3,19	2,63	4	10	7,89	12
	11-25	25,45	10,64	15,79	8	17,5	17,11	16
	26-50	38,18	29,79	23,68	20	42,5	34,21	32
	51-100	21,82	34,04	34,21	44	25	21,05	28
	More than 100	9,09	22,34	23,68	24	5	19,74	12
College Diploma	0-10	11,11	8,26	1,45	0	4,55	5	2,74
	11-25	16,67	9,17	10,14	8,47	13,64	13,75	15,07
	26-50	27,78	36,7	28,99	20,34	34,09	18,75	33,56
	51-100	38,89	33,94	37,68	37,29	20,45	33,75	34,25
	More than 100	5,56	11,93	21,74	33,9	27,27	28,75	14,38
University Degree	0-10	1,67	6,25	0	0	1,12	2,11	1,29
	11-25	10	4,46	4,76	5,13	7,87	7,37	12,5
	26-50	16,67	23,21	9,52	12,82	28,09	21,05	28,88
	51-100	28,33	36,61	42,86	33,33	38,2	32,63	31,47
	More than 100	43,33	29,46	42,86	48,72	24,72	36,84	25,86
Total	0-10	16,29	11,61	10,6	1,87	10,62	8,21	12,7
	11-25	24,64	11,99	26,43	9,36	25,43	16,72	24,49
	26-50	29,53	29,21	26,4	28,84	32,1	31,04	31,23
	51-100	17,72	30,52	24,08	34,46	20,49	26,27	21,64
	More than 100	11,81	16,67	13,49	25,47	11,36	17,76	8,93

ECONOMETRIC SPECIFICATION

This section outlines the econometric model that will be used to analyze the effect of the parents' reading on the children's academic results.

The specification which is used is as follows:

$$S_i = \beta_k + \beta_1 C_i + \beta_2 O_i + \beta_3 M_i + \beta_4 F_i + \sum Z_h + \varepsilon_i$$

where the unit of observation is the student *i, S* is the PIRLS r reading score, *C* is a dummy variable that is equal to 1 if the reading level of the parent with the student is high and 0 otherwise, *O* is a dummy which reflects the reading level of the parent itself, being equal to 1 if high and 0 otherwise, *M* is a dummy that reflects whether the mother answered the questionnaire, *F* is a dummy that reflects whether the father answered the questionnaire, with the dummy excluded in the case of both having completed the questionnaire, *Z* are dummy variables describing the educational level of the father and the mother and ε is a stochastic error with the usual assumptions. Fixed effects are included for the *k* schools which participate in the PIRLS Study and this equation is estimated separately for the different countries in 2006 and for Spain in 2011.

The model is first estimated by ordinary least squares using the PIRLS procedure, see PIRLS (2008), which involves the estimation of five different regressions to obtain estimators of the coefficients, as well as 80 additional regressions to obtain the standard errors of the estimators. The different sample weights supplied by the database are also used.

Taking into account the possible endogeneity of the reading variables, the model is subsequently estimated, using as instruments for the reading variables the amount of books in general and the amount of children's books in the household. It is assumed that the variables on the resources of books are exogenous, given that these resources are related to the acquisition of education by the parents, and at the moment of making decisions related to the children the parents' education is predetermined. Due to the specific nature of estimation with the PIRLS data which requires the use of plausible values, this estimation is made using least squares in two-stages. Firstly reduced forms are estimated for the reading variables using all the exogenous variables:

$$R_i = \beta_k + \beta_1 GB_i + \beta_2 CB_i + \beta_3 M_i + \beta_4 F_i + \sum Z_h + \varepsilon_i$$

where *R* is the reading variable in question (two equations are estimated, one with own reading and the other with reading with the children), *GB* is the amount of general books in the home, *CB* is the amount of children's books in the home and the other variables are the same as in the initial equation.

The initial equation is subsequently re-estimated but now using the values predicted by the reduced forms for the reading variables. This procedure in two stages usually requires the correction of the standard errors, because predetermined variables are being used in the

second stage, but in our case the standard errors are estimated directly with the PIRLS procedure so that no further correction is required.

RESULTS

This section presents the results of the estimation.

Tables 2.6 and 2.7 present the reduced forms for the two-stage estimation of the effects of reading on the academic results. The columns headed by (1) show the estimates not including the controls for education of the parents, while the columns headed by (2) are estimates including controls for education of the parents. The case which is excluded within the education dummies is that of finished compulsory secondary education, both for fathers as well as for mothers.

Table 2.6 presents first of all the effects on the reading of the children. The estimated model is a linear probability model where the dependent variable is a dummy variable equal to 1 if the family reads to the children frequently. As can be seen, both the amount of children's books in the home and the books generally have a positive and statistically significant effect on the probability that parents will read to their children. The size of the effect is similar for the different countries of the comparative sample, just as for PIRLS 2006 and 2011 for Spain.

Regarding differential effects for fathers and mothers, while they are not significant for all of the studied samples, they show a pattern where parents systematically have a slightly lower and significant propensity to read to the children than the mothers. This result should be interpreted with caution, because the gender variables of the parents are constructed based on who has responded to the survey, so that despite the fact that, for example, it was the mother who has responded to the survey, it is possible that the father may also participate in the reading activity with the children.

Table 2.7 shows a similar estimation where the dependent variable is the parents' own reading. The estimated coefficients of the variables of amount of children's books and amount of books in general are still positive and significant in almost all cases, and they are clearly so in the case of the two included Spanish samples. The gender effect, on the other hand, does not seem to have such a clear impact on the probability of the parents' own reading, since the significance of these variables is much smaller than in the previous case. This result should still be read with caution, because the gender distinction is made based on whether the one answering the questionnaire is the mother or the father, and the parent who responds does not necessarily refer exclusively to himself/herself alone but in many cases also often answers for both parents.

The reduced forms for reading to students and the families own reading are used to implement these variables in the second stage. For this reason the predicted values are calculated by these two equations, and these predicted values will be used instead of the original data in the equations of the second stage.

Table 2.6: Reduced forms for reading to kids

	Austria		Denmark		Germany		Iceland	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Children's books	0.131***	0.120***	0.086***	0.078***	0.139***	0.131***	0.080***	0.073***
Books in general	0.053***	0.042***	0.073***	0.054***	0.051***	0.037***	0.051***	0.033***
Mother	0.117***	0.112***	0,011	0,002	0,039	0.038***	0.067**	0.066**
Father	-0.062**	-0.069**	-0.093***	-0.097***	-0.197***	-0.199***	-0,034	-0,029
Constant	-0.129***	-0.163***	0.117***	0.144***	-0,026	0,012	0,228	0.244***
R^2	0,194	0,203	0,135	0,155	0,208	0,219	0,078	0.100
Observations	4541	4541	3622	3622	6581	6581	2706	2706

	Spain		Sweden		Spain 2011	
	(1)	(2)	(1)	(2)	(1)	(2)
Children's books	0.104***	0.092***	0.104***	0.098***	0.087***	0.083***
Books in general	0.088***	0.065***	0.069***	0.049***	0.078***	0.061***
Mother	-0,009	-0,013	0,016	0,022	0,116	0,023
Father	-0.109***	-0.105***	-0.052*	-0.044*	-0.148***	-0.155***
Constant	-0.149***	-0.108***	0,047	0.090***	-0.058***	-0.065**
R^2	0,179	0,195	0,153	0,168	0,149	0,168
Observations	2399	2399	3983	3983	7576	6450

Fixed effect by school are included, * significant 10%, ** 5%, *** 1%

Table 2.7: Reduced forms for parent reading

	Austria		Denmark		Germany		Iceland	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Children's books	0.037***	0.031***	0,005	0,002	0.033***	0.028***	0.052***	0.044***
Books in general	0.131***	0.123***	0.135***	0,118	0.152***	0.141***	0.128***	0.106***
Mother	0.035*	0,028	-0.045**	-0.051**	0.035**	0.034**	0,028	0.030
Father	0.118***	0.113***	-0,024	-0,031	0.041*	0.040*	0.020	0,029
Constant	-0.183***	-0.161***	-0.058*	-0,026	-0.185***	-0.158***	-0.206***	-0.200***
R^2	0,157	0,169	0,124	0,139	0,171	0,176	0,104	0.130
Observations	4541	4541	3622	3622	6581	6581	2706	2706

	Spain		Sweden		Spain 2011	
	(1)	(2)	(1)	(2)	(1)	(2)
Children's books	0.047***	0.034***	0.010	0,006	0.043***	0.036***
Books in general	0.119***	0.092***	0.128**	0.107***	0.118***	0.100***
Mother	-0.085***	-0.079***	0,008	0.010	-0.032**	-0,023
Father	-0,028	-0,032	-0,006	-0,016	0,023	0,023
Constant	-0.087**	-0,028	-0,038	0,012	-0.097**	-0.101***
R^2	0,142	0,162	0,089	0,108	0.140	0.150
Observations	2399	2399	3983	3983	7576	6450

Fixed effect by school are included, * significant 10%, ** 5%, *** 1%

Tables 2.8 and 2.9 present the estimates of the second stage. Table 2.8 shows the ordinary least squares estimation, that is without using the previously estimated reduced forms, while Table 2.9 presents the estimate by instrumental variables. In both cases the dependent variable is the reading result of the PIRLS study, measured by the percentage position of the student on the scale of 0-100 for all the students of each sample. As in the previous tables, the columns headed by (1) show the estimates excluding the controls for parental education, while the

columns headed by (2) are estimates including the controls for parental education, where the excluded level is that of the mother and father with finished compulsory secondary education.

The estimation by ordinary least squares shows a positive and significant effect of both family reading with the children as well as the parents' own reading. Gender effects, on the other hand, are generally not significant, except for Austria, where the results climb four percentage points if the survey is answered only by the mother or only by the father, compared to the case where both answer, which is then excluded. However, take into account that the variables that refer to gender may be affected because whoever fills out the survey provides information on both parents.

In order to read the results, we have to take into account that the constant expresses the percentage position of a student whose parents do not read and, in the case of model (2), whose mother and whose father have finished compulsory secondary education. For example in the case of PIRLS 2011 Spain, this student would occupy the 52.6 percentile in the event that no controls about parental education are included, and 42.40 in the event that they are included. The fact that parents read to their children would increase the percentage position by 9.13 points in model (1), and 7.15 points in model 2, both coefficients being significant at 1%. If, furthermore, the parents also read themselves, this would allow students to climb 5.19 points in model (1), and 2.69 points in model 2, the effects again being clearly significant. The effects are similar for the different comparison samples included, as well as for the PIRLS 2006 data for Spain.[3]

Table 2.8: OLS estimation

	Austria		Denmark		Germany		Iceland	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Reading to student	14.32***	12.27***	12.63***	10.15***	13.45***	10.86***	14.42***	12.17***
Own reading	7.51***	5.52***	2.40*	0,41	7.11***	4.87***	4.98***	2.70**
Mother	4.42***	3.30**	-0,34	-0,51	0,77	0,59	-2,67	-1,3
Father	4.78**	3.88**	-0,91	-1.00	0,05	-0,44	-0,12	0,59
Constant	35.40***	25.25***	63.81***	53.38***	22.44***	21.50***	0,026	23.69***
R^2	0,26	0,29	0,19	0,23	0.30	0,34	0,16	0,21
Observations	4631	4631	3651	3651	6651	6651	2726	2726

	Spain		Sweden		Spain 2011	
	(1)	(2)	(1)	(2)	(1)	(2)
Reading to student	12.27***	10.07***	11.43***	8.66***	9.13***	7.15***
Own reading	3.65***	1,35	23.92***	2.07*	5.19***	2.69**
Mother	-3,55	-3.00	-2.52*	-1,33	-2.70*	-2.70**
Father	-2,15	-2,11	-1,47	-1,26	-1,23	-1,01
Constant	24.90***	32.79***	66.38***	54.08**	52.6***	42.40***
R^2	0,27	0,31	0,17	0,23	0,26	0.30
Observations	2429	2429	4024	4024	7665	6507

Fixed effect by school are included, * significant 10%, ** 5%, *** 1%

[3] These results are consistent with the simple statistical analysis provided by Blanco Fernández et. al. (2013).

The problem with the OLS estimation is that the parental reading activity and students' academic performance may be determined jointly, as we have argued above, so that the estimates shown above may be subject to bias. Alternatively, it is very possible that the variables of own reading time and that with the children, being responses to a survey for parents, may show a significant measurement error. One instrument which seems appropriate for correcting these problems is the number of books owned by the family, which may possibly be more reliable in the answers than that of reading time, and that we can also assume to be exogenous to school performance because it is based on a prior investment in learning resources. For this reason the estimation by instrumental variables is suggested, as shown in Table 2.9.

Table 2.9: Estimation by instrumental variables

	Austria		Denmark		Germany		Iceland	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Reading to student	31.63***	29.45***	30.48***	27.30***	42.06***	40.72***	62.15***	60.59***
Own reading	20.97***	19.65***	13.38**	10.99*	6,01	1,12	-0,75	-4,17
Mother	-0,17	-0,29	-0,17	0,19	-0,79	-0,69	-4.73**	-3.72*
Father	3,53	3,28	2,28	2,02	6.70***	6,47	3,05	3,28
Constant	21.09***	16.41***	42.27***	37.75***	5.35**	6.75**	0,03	-5,87
R^2	0,28	0.30	0,21	0,23	0,33	0,35	0,16	0.20
Observations	4541	4541	3622	3622	6581	6581	2706	2706

	Spain		Sweden		Spain 2011	
	(1)	(2)	(1)	(2)	(1)	(2)
Reading to student	29.30**	30.36**	22.28***	19.31***	40.98***	39.99***
Own reading	10,75	2,46	25.52***	20.17**	-3,46	-13,96
Mother	-2,26	-2,52	-2.38*	-1,58	-2.63*	-3.40**
Father	0,79	0,54	1,06	0,79	4.86*	5.21*
Constant	24.98***	25.25***	45.77***	40.34**	39.14***	34.83***
R^2	0,28	0.30	0.20	0,23	0,27	0.30
Observations	2399	2399	3983	3983	7576	6450

Fixed effect by school are included, * significant 10%, ** 5%, *** 1%

In the instrumental variables estimation the results change significantly. Firstly, the magnitude of the coefficients is larger, something which can be attributed to the fact that the instrumental variables method allows the correction of measurement errors. But the most notable change is that, except for samples from Austria and Denmark from PIRLS 2006, the effect of parents' own reading becomes statistically insignificant, once we us the number of books that exist in the home as an instrument. This result seems to confirm the previous results of Levitt and Dubner (2005), in that the educational background of the parents, in this case measured by the number of books they own, seems more important than the activity of reading itself. An alternative explanation is that the correction of the measurement error, which the estimation by instrumental variables allows, eliminates the effect we observed in the OLS estimation. This result, however, does not seem to apply to reading in front of the children, which still has a positive and statistically significant effect despite implementing it by the number of books in the home. In particular, in the case of PIRLS 2011 for Spain, a student who the parents don't read to occupies an average position corresponding to the 39.14 percentile, if we don't take into account the parents' education, and 34.83 if linked to finished compulsory secondary

education. The very fact of parents reading to the student means it moves up by 40 percentage points, whether we take into account the parental education or not. The factor of parents' own reading, on the other hand, does not appear to have any significant effect, once we implement it by the number of books they have at home.

CONCLUSIONS

In this paper we have used the PIRLS 2011 study, and some of the PIRLS 2006 samples for comparison purposes, to provide new empirical evidence on the effects of time devoted by parents to reading, both their own and with their children, on the school performance of students. The analysis of the causal effects of family involvement on school achievement is a topic which has not been extensively studied in the economic literature.

Firstly an initial description of the data allows us to observe that the Spanish parents' level of dedication to reading activities, both their own and with the children is significantly lower than in other neighboring countries. This result is valid not only in general but also for the different educational levels of parents. A descriptive analysis of the other variables used in this paper, which is the number of books in general and the number of children's books, also brings up an unfavorable comparison for Spanish families.

Taking into account the possible endogeneity of the variables of reading, both through the joint determination with school performance as well as through possible measurement errors, the effect of parents' own reading and reading with their children on school performance in reading is estimated by the method of instrumental variables, finding that there is a positive and significant impact of reading activities with the students by their families, while their own reading activities are not statistically significant. Besides, bearing in mind that the instruments used are the number of books in general and the children's books in the home, it can be concluded that in order to understand the effects of family involvement on students' reading we should take into account the learning resources that are in the home.

From the point of view of education policy, this paper emphasizes the importance of the availability of resources and attitudes conducive to learning for the school performance of the students. In particular for the Spanish case, taking into account the relative delay shown by the data regarding family involvement and learning resources at home, it suggests that encouraging the family policies which reinforce these aspects may have a positive effect on educational improvement.

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Chapter 3

Socioeconomic Level, Type of School and Educational Results in Spain:

the Case for Spain – TIMSS PIRLS 2011

SOCIOECONOMIC LEVEL, TYPE OF SCHOOL AND EDUCATIONAL RESULTS IN SPAIN: THE CASE FOR SPAIN - TIMSS PIRLS 2011

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INTRODUCTION

The analysis of the determinant factors of the academic results of students is one of the most important issues when starting to think about education reforms. Economics has shown for many years now the relationship between economic growth and the educational level of workers from a quantitative viewpoint. In the most developed countries workers have higher education levels than in the less developed countries. Although the direction of causality can be difficult to identify, some studies are quite clear in showing that education is a precedent to growth. In the last decade, economic research has moved from the measurement of the quantity of education, and its effect on growth, to the measurement of education quality. The measure of the quality of education is controversial but, in general, measures based on inputs (percentage of GDP spent on education, expenditure per student, etc.) provide ambiguous results, while the results from the use of tests of standardized knowledge as a measurement of the output of the production process of education, are compelling. Hanushek and Woessmann (2008, 2010) measure cognitive abilities by combining information from international tests over the last 45 years to get a measurement of ability from each country, which could be used to index the relative capacity of the individuals in the job market. Between 1964 and 2003, 12 different international tests of maths, science and reading took place, administered in a group of countries that decided to participate voluntarily. This involves 36 possible combinations of tests based on the year, age group and type of test. These authors focus the analysis on maths and science tests (the majority) which are highly correlated with the results of the reading tests. The goal is to construct a national consistent measure to compare the relative capacity between countries.[1] Hanushek and Woessmann (2008, 2010) have developed a research program based on the idea that it is the quality of educational results, not the length of time in schooling, what really matters. Hanushek and Woessmann (2010) conclude that an increase of 25 points in PISA (equivalent to ¼ of standard deviation) would imply an increase of 115 billion

[1] The details of the construction of this variable appear in Appendix A of Hanushek and Woessmann (2010).

dollars adjusted by Parity of Purchasing Power (PPP) in terms of future value discounted until 2090.

The aim of this paper is to analyze the results of the TIMSS-PIRLS 2011 study for Spain with special emphasis on the effect of socioeconomic level and type of school (public or private). In the international context the majority of recent studies on TIMSS analyze the temporal evolution of the results in a particular country or set of countries, as well as its breakdown according to factors such as the level of inequality. Sahn and Yonger (2007) use data from TIMSS 1999 and 2003 and conclude that over 50% of educational inequality corresponds to inequality within countries. For the breakdown they use the generalized entropy index. Sakellariou (2012) breaks down the increase of the TIMSS scores of Ghana between 2003 and 2007. The study concludes that the improvement was heterogeneous: in mathematics the improvement was due more to students who already had good scores. By contrast, in science the increase was due to the effect of the students in the lower part of the distribution. Most of the increase in both science and mathematics is due to changes in the coefficients. Unfortunately in the case of Ghana the data do not distinguish between public and private schools although there is a reasonable suspicion that the large increase in private schools has an influence in the improvement of scores. Finally, the difference in score by population size (large cities against villages) over time coincides with the narrowing of the distribution of students with lower scores and the expansion of the distribution in the case of the best scores.[2]

In the Spanish case a temporal analysis is not possible because Spanish students only participated in the 1995 TIMSS prior to 2011 and, for some reason, these data have not been used for research, not even by the TIMSS team, something which calls into question the representation and/or the quality of the data. For this reason, and although it would undoubtedly be very interesting to analyze the temporal evolution and the breakdown of inequality over time, etc., it doesn't seem possible to continue this line of research.

However, the data from 2011 have a positive aspect: the frequency cycle of TIMSS and PIRLS coincides with what can be drawn from the results of three different subjects for the same students. This data structure allows us to analyze the determinant factors of the results in each subject using cross-sectional data. For example, the Ghana study shows the interest of such comparisons over time. The issues raised in this study have their origin in the differences in the results in all three subjects. Is the explained proportion of variance between schools similar for all three subjects? Does socioeconomic status have the same effect on the differences between students in the three subjects? And on inequality within each school? Is the public/private school dichotomy relevant to the differences between the results of the three

[2] Wu (2010) presents a very interesting paper which compares the similarities and differences of TIMSS and PISA, which allows a better use of the different existing tests to analyze the impact of the quality of education on economic growth after the homogenization of the available evidence

subjects once the socioeconomic status of the family is considered? To answer this type of questions we propose the use of HLM or "hierarchical linear models" as the reference methodology.

DATA ANALYSIS

This section presents the analysis of the data of the TIMSS-PIRLS 2011 proyect for the Spanish case. Firstly we describe the sample design of the project so that then we can go on to carry out a subsequent descriptive analysis.

Sample Design

To perform the analysis of the Spanish data from the TIMSS-PIRLS 2011 study it's necessary to know the technical characteristics of the sample. The TIMSS and PIRLS international studies have a design based on a stratified two-staged sampling. In the first stage schools are sampled with a probability proportional to their size, from the list of all schools in the population which contain eligible students. In a second stage one or more entire classes of the schools chosen in the first stage are selected. Classes smaller than a minimum are grouped into pseudo-classes within each school. In general, in the last TIMSS most of the countries defined the population of eligible students as those in the fourth grade (for TIMSS and PIRLS) and in the eighth grade (only for PIRLS). In Spain only fourth graders participated.

Therefore, the basic procedure is consistent with two stages which use a selection technique based on the probability poportional to size. Schools are initially chosen and then the classes are selected whithin the sample of the participating schools. Schools are stratified to improve the efficiency of the sample design. The stratification is done in two ways: explicit and implicit. Explicit stratification creates smaller sampling frameworks from which the sample is taken. In TIMSS this stratification is used if it is required to over-represent a particular interest group of the population. Implicit stratification only requires schools to be ranked according to the variable which defines such stratification before performing the sample and it can be nested in the explicit stratification. The TIMSS project allows each country to select the variables that seem most appropriate for both types of stratification, implicit and explicit. In the Spanish case, in 2011, the variables used for the explicit stratification were the autonomous regions and the variables of the implicit stratification were public and private schools. In Andalucia, which appears as an independent study in the relationship of participating regions/countries in TIMSS-PIRL 2011, the public/private distinction was also used to define the implicit stratification.[3]

[3] See TIMSS 2011- Grade 4 Stratificacion Variables, http://timssandpirls.bc.edu/methods/pdf/Stratification_G4G8.pdf

The accuracy of the estimators of the results of the students. To meet the TIMSS and PIRLS sample accuracy standards, the national samples should have had a standard error of no more than 0.035 standard deviations for the outcome of the national average. The sample estimators of any percentage estimated at student level (eg: family characteristics, etc.) should not exceed the confidence interval of ± 3.5%. For most countries this meant making a sample of 150 schools and about 4,000 students in each level (fourth and eighth). Accordingly, in the Spanish case, 150 schools and 4,183 students were sampled (TIMSS). In the PIRLS case, the number of students went up to 8,580, basically because of the interest of Andalucia and the Canary Islands in having a reinforced sample in order to obtain results with higher statistical accuracy for those autonomous regions.

Obviously this design and the possibility of having reinforced samples make the sample weights a very important issue. There are three types of components in the total weight assigned to each student. That total weight is obtained by the product of the weights of the school, the class within the school, and the student (within the class). Each of these components is adjusted by non-participation. Thus the total sample weight of a student, defined as TOTWGT in the database, is the result of multiplying the theoretical weight of each component (school, class and student) multiplied by a corrective coefficient that adjusts for the non-participation of schools, classes and students.

TOTWGT= WGTFAC1*WGTADJ1*WGTFAC2*WGTADJ2*WGTFAC3*WGTADJ3

Where WGTFAC1 is the school weight; WGTADJ1 is the adjustment for the non-participation of the school; WGTFAC2 is the theoretical weight of the class, WGTAD2 is the correction factor for non-participation of a class; WGTFAC3 is the theoretical weight of the student; and WGTADJ3 is the adjustment for non-participation.[4]

Description of the data: basic aspects

Statistical work with TIMSS and PIRLS data must take into account the way in which the scores of the three tests are constructed. The values that appear as a result of the tests are "plausible values", PV. TIMSS, PIRLS provide five PV. The PV were originally developed for the NAEP (National Assessment of Educational Progess) survey of 1982-83. This methodology has been used for the following studies of the NAEP, the TIMSS and now the PISA survey. Basically the PV are values imputed using multiple imputation methodology originally proposed by Rubin[5] which approximate the distribution of latent features that are intended to be measured. The fundamental methodological problem is that the knowledge or ability must be inferred and can not be observed directly. The PV are a type of estimator of latent capabilities of the students in different subjects. Since carrying out a single test is often impossible, educational organizations have developed statistical tools that allow the results of different tests to be

[4] See Appendix I which describes the different weights calculated in the TIMSS-PIRLS project.

[5] The basic techniques can be found in the seminal work by Rubin (1987).

expressed in a unified scale. In this case, the combinations of booklets with different questions prevents a direct and simple comparison of the student results. One of the techniques most often used to perform this task is the theory of IRT (Item Response Theory) used by TIMSS and PIRLS. The basis of this theory is the modeling of the behavior of each question (its difficulty, ability to discriminate between two students and probability of being guessed) so that any differences in the questions can be eliminated from the final score. [6] The key element of IRT is the IRF (item response function) that relates the capacity, which is an unobservable variable, θ, to the probability that a randomly selected student answers the question correctly. The most popular model for dichotomous answers is the 3PL Logistic model introduced by Birnbaum (1968) and used by TIMSS for multiple choice questions. If X_{ig} is considered the answer (0/1) of an individual, and the question is considered g, the IRF for a 3PL model would be:

$$P_g(X_{ig} = 1|\theta) = c_g + \frac{1 - c_g}{1 + \exp\left[-1.7a_g(\theta - b_g)\right]}$$

Where c_g is the pseudo-guess parameter which approximates the fact that in multiple choice tests, even the ones who get the worst results sometimes guess the right answer; the difficulty parameter, b_g, which measures the difficulty of the question, since getting the right answer not only depends on the student's ability but also on the difficulty of the question; and the discrimination parameter, a_g, which reflects how quickly the probability of getting a correct answer changes with respect to the ability of the tested student.

Given that individual knowledge is measured with error, the variance of the distribution of the aggregated results from the ML estimators of individual knowledge overestimates the true variance. An alternative method, developed by Mislevy, Beaton, Kaplan and Sheehan (1992) is to obtain samples from the a posteriori distribution of each spread of student results in order to get an unbiased measurement of the overall learning distribution. These extractions are the PV and are interpreted as individual results with the characteristic that when added to the population distribution, the correct moments can be retrieved. In particular if we assume that the 3PL model, which will be the distribution conditioned to the ability f(X|θ), represents the probability of a correct answer and that the distribution of knowledge is normal

$$g(\theta) \sim N(\mu, \sigma^2)$$

It can be shown that the extractions should be made from the *a posteriori* distribution

$$h(\theta|x) = \frac{f(x|\theta)g(\theta)}{\int f(x|\theta)g(\theta)d\theta}$$

[6] This approximation is very different from the usual ,which consists of considering the percentage of questions with right answers that provides results on a scale that is specific to a particular test.

So if the pattern of responses of a student is X, then the a posteriori distribution of θ is given by h(θ|X). The PV for a student with an X response pattern are random extractions of the probability distribution of h(θ|X). Thus the PV provide not only information about the parameter that reflects the student's ability but also the uncertainty associated with this estimator. If we get many PV for each student these will form an empirical distribution for h(θ|X). Therefore, if a researcher can get a certain number of PV for each student, an empirical distribution of each student can be constructed. This is done because there is no closed form for the conditional distribution. For TIMSS and PIRLS five plausible values for each student are provided. Although these PV obviously can not be used to report on the students grades, they have obvious advantages. In the first place, they allow the estimation of population parameters that would be biased if a one-off estimatior were used instead. Also, the PV facilitate the calculation of standard errors of the estimators in complex sample designs. In particular the mean average of the plausible values for each student would be a biased estimator while using only one of the PV of each student would provide unbiased estimators.[7]

Table 3.1 takes into account the comments above and calculates mean averages and standard deviations of the scores in maths, science and reading tests by several classifications. The procedure for obtaining the empirical distribution uses Jacknife-type repeated replications with the JKZONE variable as the categorical one which specifies the different sampling areas and the JKREP variable as the one which specifies the weight of each observation of those areas. The variance is calculated using the expression.[8]

$$Var(t_{PV}) = Var_{jrr}(t_1) + Var_{imp}$$

Where the first component is the sample variance of the first PV and the second is the imputed variance.

Table 3.1[9] shows a difference of 11.2 and 9.6 points in favor of boys in maths and science respectively. Girls scored 4.5 points higher than boys in reading ability. The three results are statistically significant. The type of the school also gives a statistically significant difference when comparing unconditioned estimators. The difference is around 18 points for the three disciplines in favor of private schools. Socioeconomic status is one of the most difficult variables to calculate (see discussion in the next section). Table 3.1 was obtained with the combination of the parents' educational level and occupation.[10] At first it has been constructed so that the combination of higher-level occupations and higher education level is level 4 while the combination of elementary occupations and a low educational level is level 1. As it can be seen in the table, levels 2 and 3 are more diffcult to interpret becasue they combine a high education level with low level occupation and a low education level with

[7] See Wu (2005) for an overview about the interest of the use of plausible values.

[8] See TIMSS 2003 User Guide for the International Database, page 2-52.

[9] The results in Tables 3.1-3.3 were obtained using the PV program from STATA.

[10] Appendix II explains the construction of this indicator.

higher-level occupation. Intermediate levels 2 and 3 are significantly different from level 1 and level 4 but are very similar to each other. In fact, in the case of reading, the average score of level 3 is lower than the one measured in level 2.

Another important aspect is the year of entry into primary school. Table 3.1 shows that a late entry in the primary education system implies a significant decrease in the score on the three tests (see the contribution of Hidalgo and Garcia). An early entry to primary school also has the same effect although, while being statistically significant, is not as important as in the case of late entry.

Finally, Table 3.1 focuses on the size of the class and on the tests results. Because it refers to the size of the current class, this variable can not control the historical evolution of the sizes of the classes which the survey respondents have previously attended. Besides, the differences presented in Table 3.1 are small and not very significant.

Tables 3.2 and 3.3 show the same information but for boys and girls respectively. With respect to the type of school they clearly show a greater effect of the private shool variable in boys than in girls compared to the average scores of students that attend public schools. The most important differences with respect to socioeconomic status between boys and girls focus on the comparison between the lowest level and the next one. For girls, the difference is clearly higher than boys in maths and science. The results regarding the the moment of entry to primary school do not show differences in their impact on educational performance in boys and girls. Finally, although the interpretation of this fact is conditioned by the previous comments, boys and girls of the largest classes get the best scores.

STATISTICAL ESTIMATION OF THE DETERMINANT FACTORS OF RESULTS

The results presented in the previous section show an overview of some important aspects of the TIMSS and PIRLS tests without controlling by all the other factors that may have an effect on the observed scores. This section discusses in detail whether the differences obtained in Tables 3.1-3.3 and their statistical significance are maintained when controlled by other factors.

Determinant factors of the tests results

The study of the determinant factors of scores in TIMSS has a long tradition. Martín et al. (2000) serve as a basic reference. These authors use a two-level HLM model (for students and schools). The "within school" model considers an index composed of family background (HBI) calculated from the standardization of each variable and then taking the average for the non-missing values. The components are the number of people in the family, presence of the natural father in the family, the books in the house, the percentage of certain possessions, whether there is a desk at home and/or a computer, the highest level of education attained by

the father and highest educational level attained by the mother. For the "between school" model the following characteristics are used: class (existence of exercise lists, quantity of lists, correction of exercises in class, attitude towards mathematics, class size and school environment), the teacher (experience), school environment (breach of administrative regulations and serious behavioral problems), location and size of the school (urban location and average class size above the national average), aspirations (the student plans to attend university, the mother or students themselves believe that is important to have good grades in maths).

The NCES (2001) performs a comparative study in which, after removing the non-significant variables of the HLM general model with a "stepwise" procedure, ends with an specification that includes eight variables: the presence of the father in the family unit, the number of books in the house, whether there is a computer, whether the mother believes it is important to have good grades in maths, having been born in the county of the survey, the mother's education, father's education and age. Both Martin et al. (2000) and NCES (2001) use data from TIMS 1994-1995. Obviously there are many other studies that use different sets of variables although the relevant ones are usually quite similar.[11]

In the aforementioned studies the socioeconomic status is approximated from parents' educational level or family possessions (books, internet, other assets). Using education as a proxy of socioeconomic status is particularly questionable in the Spanish case given the high level of over-qualification in the labor market. The consequence of the difficulties of the Spanish production system to absorb the labor supply with high education level is overqualification. [12] A recent study by the OECD (2010) notes that overqualification of young graduates between 25 and 29 years old reaches 44%, which is double the OECD average.[13] García Montalvo, Peiro and Soro (2006) estimate the proportion of young graduates under 30 who are overqualified as 37.8%.[14] It could be considered that overqualification is a temporary phenomenon that disappears over time, but the results of García Montalvo and Peiro (2009) do not support this interpretation. Overqualification of Spanish graduates is a fairly permanent phenomenon. In fact, the improvement of the adjustment between education level and employment comes about in a psychological sense more than in a real one. The university students who have spent a long time in a job which is below their qualification levels end up thinking that their abilities have depreciated and that the job they have fits with their education level, even when the tasks of the job have not changed.

[11] See also Wobmann (2003) and Hidalgo-Hidalgo and Garcia-Perez (in this volume).

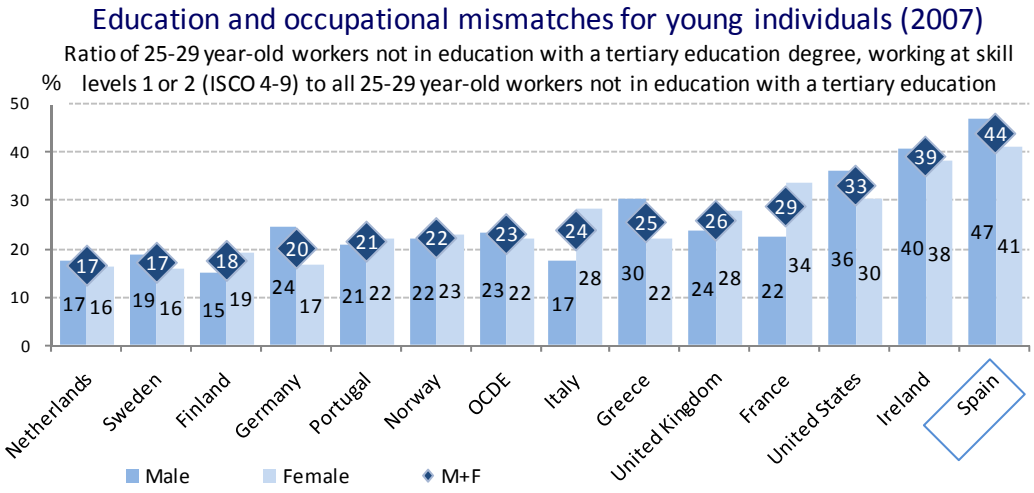
[12] The problem of over-qualification is not only due to lack of capacity of the production system to absorb the supply of college students/graduates. The low quality of some universities and studies may also explain the lack of demand or low qualifications of the positions offered at many universities.

[13] The measurement of overqualification used by the OECD is based on the comparison of education level with the classification of occupations to 1 digit. The procedure is similar to one of those proposed in Montalvo Garcia (1995). The Eurydice report (2005) states that 40% of young graduates between 25 and 24 are overqualified.

[14] This study measures subjective overqualification.

This inertia of overqualification transfers to the parents of the polled students since these imbalances have been taking place for a long time.[15] It is well known that the salaries of overqualified workers are substantially lower than the wages of those who are properly suited to their job.[16] Therefore, from a strictly economic position, families with higher levels of studies are not necessarily associated with higher incomes. An example of how the association of the parents' educational level and socioeconomic status may fail has been discussed in the data analysis section. The positive effect that the socioeconomic status has on the results is one of the most consistent aspects of the study of educational results. However, we have seen how students who have parents with university education but elementary occupations have similar, or even lower, results compared to those of students who have non-graduate parents in non-elementary occupations. Therefore, although the educational level of the parents will obviously be a significant variable in the explanation of results, the measurement error can be very significant.

Figure 3.1 Overqualification in the Spanish labor market



Source: Education at a Glance 2010. OECD

Another important aspect that has not been extensively considered in the literature that specifically addresses the TIMSS and PIRLS assessments is the importance of early interventions and the moment of entry to primary education.[17] García-Montalvo (2012) suggests, based on available evidence, that funding for early educational interventions should be a priority even in a reduced public budget context. More detailed analysis of these groups

[15] See Alba-Ramírez (1993), García-Montalvo et al. (1997), García-Montalvo y Peiro (2001) or García-Montalvo (2001).

[16] García-Montalvo (2008).

[17] An exception is Hidalgo-Hidalgo and García-Perez (in this volume) which focus precisely on the impact of attending pre-school education on the results of the TIMSS-PIRLS 2011.

of variables (socioeconomic status and importance of early interventions) is carried out in the following sections.

Socioeconomic status

Socioeconomic status is probably the variable most commonly used in educational research, and certainly one that is most probably statistically relevant. [18] However the measurement of socioeconomic status has its difficulties. There is considerable agreement that the nature of socioeconomic status is related to household income, education level of parents, occupation of parents and other family resources such as the possession of books, computers or study rooms. Usually this factor is considered separately and, apart from some exceptions, not added in the commonly used socioeconomic indices. The occupational component has a ranking based on education level and income required for a particular occupation. Occupational measurements such as Duncan's Socioeconomic Index (1961), produce information on social and economic status of a family not only because of the relationship between education, income and occupation but also because they contain information on the prestige of a particular socioeconomic level.

This paper uses the International Socio-Economic Index (ISEI) of occupational status from the International Standard Classification of Occupations as an indicator of socioeconomic status. The work of Duncan (1961) already states that occupation is a variable which mediates in the relationship between education level and income. Duncan (1961) chooses average education and average income as the basic variables to construct his socioeconomic index but he derives the relative weights of the two variables in a way that the joint correlation with prestige is maximized. The ISEI indicator suggested by Ganzeboom et al. (1992) is based in the same principle (occupation as the mediating variable) but the scale of occupations is constructed so as to capture the indirect influence of education on income in the most intense way possible. Thus the ISEI score would be a latent variable that would maximize the indirect effect of education on income and would minimize its direct effect. The result is obtained by "optimal scaling" techniques. In the process it is controlled by the effect of age on the three variables. In summary, the ISEI score is a measurement of the occupational attributes that transform a person's education into income.

First formative stages

The scientific evidence of the importance of intervention in the early stages of child development is growing quickly.[19] The differences in abilities, both cognitive and non-cognitive, between individuals from different social strata are generated very early on.[20] At 5

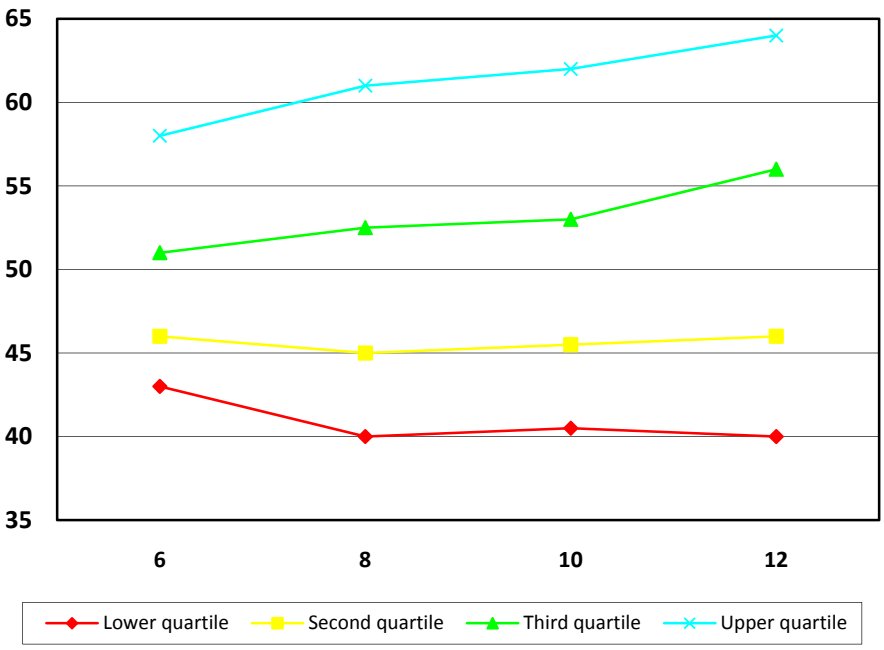
[18] See meta-analysis of the effect of socioeconomic status on cognitive test results in Sirin (2005).

[19] Currie (2001) provides an overview.

[20] For a recent overview of this topic see Cunha and Heckman (2010).

or 6 years old there already are significant differences in cognitive abilities between children of different socioeconomic status. Figure 3.2 shows the evolution by age of the results of the maths test, Peabody Individual Achievement Test (PIAT), based on the New York Longitudinal Study (NYLS) information. These differences will remain essentially stable over the subsequent years. In general, the later the interventions on children with difficulties start, the less effect they have.

Figure 3.2. Cognitive tests results by income quartile



It is well known that the children's ability level is highly correlated with the level of the parents' income.[21] The problem is not only the development of cognitive abilities but, above all, the non-cognitive abilities. Once the child enters the formal education system, deficiencies in the development of abilities at an early age will show an inferior academic performance than those children in higher socioeconomic groups. Therefore, if the goal is to maintain equity, public interventions should focus on the earliest stage of childhood. Equity can not be accomplished at the university. Increasing family income by subsidies or reduction of university fees when the student is already at the life stage of attending university has practically no effect in compensating the previous low levels of investment. Inequalities must be addressed at the source and not in the entrance to the university. Furthermore, the high social profitability of interventions at an early age justifies an intense participation of public funding.

Therefore, it is increasingly clear to researchers that what happens before the preschool age is critical. The type of care that children receive in the first three years of life is very important

[21] In the Spanish case, the work of Anghel and Cabrales (2010) provides the most convincing evidence.

for certain biological effects related to the ability to pay attention and learn. The concept of "school readiness" does not mean emphasizing academic content before pre-school. "School readiness" refers to arriving at pre-school with a brain which is prepared and able to learn. The learning process begins long before reaching pre-school since synapsis begins to occur from birth. The brain of a toddler of two years old has almost twice the amount of neuronal connections of an adult brain. The connections that are reinforced by repetition are lost in the process of neuronal "pruning".[22]

But, besides the biological foundations of early interventions, there are experiments that show the importance of this type of action. Two of the most renowned are the Pre-school Program of the Perry School and the Alphabet program, which show how to achieve long-term effects on the improvements of cognitive and non-cognitive skills, academic performance and labor productivity from early interventions. For example, the Perry program was administered to 58 young African-Americans in Michigan between 1962 and 1967. The treatment consisted of 2.5 hours of class every day and 1.5 hours of family visit each week. The Alphabet Program was aimed at young people from disadvantaged families born between 1972 and 1977. The average age of entry was 4.4 months. The intervention was daily. The Perry Program managed temporary improvements on the IQ (which disappeared at four years old) but the group treated at age 14 had better academic results. The explanation according to Pinto et al. (2008) would be the effect of the program on non-cognitive skills. The individuals of the Perry Program group (at 40 years old) and of the Alphabet program (at 21 years old) had better scores in the academic tests, higher education levels, required less attention through special education, had higher salaries, higher probability of having a home and less probability of ending up in prison than the individuals in the control group.

Heckman et al (2009) show that the yearly rate of social profitability of the Perry Program is between 7% and 10%. In terms of cost-benefit analysis (assuming a discount rate of 3% and taking into account the effect of taxes needed to fund the program), the result is that for every dollar spent, 7 to 12 dollars are returned to society in terms of present value.

Other recent studies have analyzed the influence of age of entry into the educational system. Bedard and Dhuey (2006) show how the effects of students' initial maturity level when they start the education process persist in the education results many years later. Black et at. (2011) find a negative effect of late entry into the education system on intelligence tests at 18 years old (small) and on wages in the labor market. Finally, Crawford et al. (2010) show the importance of the time of birth in educational results. The month of birth may mask other effects such as the impact of age when the test is taken, age of entry to primary school and the extent of education prior to doing the test. All the above factors are considered in the next section that develops the full econometric analysis.

[22] Neurological process that favors a change in the neuronal structure by reducing the weaker synaptic connections (in terms of their use) and keeps those that generate a more effficient synaptic configuration.

Statistical models

The determinant factors of students' scores can be classified into several groups according to the level of aggregation of variables: student characteristics (demographic, previous education and socioeconomic status), characteristics of the school and teacher characteristics. Appendix II presents a description of the variables used in the econometric analysis. Information of the per capita income of the Autonomous Region and the variable collected by the ISEI are added to the database. Information on the ISEI, corresponding to the last ISCO08 occupational classification, has been obtained directly from the Ganzeboom website (http://www.harryganzeboom.nl/isco08/)[23].

Following the comments made in the previous sections the variables included in the study are:

- Student characteristics:
  - Demographic: sex, age and term of birth
  - Educational: pre-school years and age of entry to primary shcool
- Socioeconomic status: father's ISEI, mother's ISEI and a dichotomous variable for the existence of more than 100 books in the household.
- School characteristics: public/private, in a big city or in a smaller town/village.
- Teacher characteristics: sex, major in the subject, diploma or graduate, master or doctorate, teacher's age and a dichotomous variable for over 5 years of experience.

Also in the multilevel hierarchical model (HLM) the ISEI average of the parents of students attending the school and the public school dichotomous variable is used to define the determinants of variable coefficients.

The TIMSS-PIRLS data present *missing values* for some of the variables considered above. One possible solution is to use multiple imputation techniques so as not to lose the sample size.[24] This imputation is complex because the variables that would be most important to guide this calculation are precisely those with more *missing values,* such as the educational level of parents. NCES (2001) concludes that a test of the modification of the imputation of *missing values* in the TIMSS study rejects the use of this technique. Bedard and Dhuey (2006) replace the missing observations with zeros, especially for some socioeconomic controls, and include a set of dichotomous variables to indicate that the data are missing. However these authors take great care to point out that the results are similar to those obtained excluding the observations with *missing values*. For these reasons this paper avoids imputing *missing values* due to the uncertainty about the quality of that imputation.

[23] Gil (2003) constructs an index of socioeconomic status for Andalusian primary school students based on a reduction by main components of a set of variables: father and mother's education, father and mother's occupation, amount of books, the existence of a place to study at home and a desk, the availability of a PC and internet connection, and family subscription to cable or satellite television. In this paper we prefer to stick to the internationally approved indicator using the number of books as a variable different to the socioeconomic index.

[24] This is the solution adopted by Hidalgo-Hidalgo and Garcia-Perez (in this volume).

Also the use of some variables that can be interpreted as endogenous, and whose direction of causality is unclear, has been avoided; in particular those variables regarding opinions and perceptions, tastes (love for maths, etc) or others that are potencially inadequate (facility in reading, interest in reading, etc.) as it would be very difficult to find instruments to avoid such causality.

To describe the average socioeconomic level of the students of the school we also avoided the use of two variables that appear in the database and that, at least potentially, could reflect that aggregate level; such as the response of the head of the school to the question about the average income of the area in which the school is located and the percentage of economically disadvantaged/well-off students. Instead, the ISEI of the students at the level of each school has been added.

The statistical modelization is based on mixed linear models or hierarchical linear models (HLM) with stochastic coefficients (containing fixed effects and random effects). This choice has multiple justifications. First, the two-stage sampling design (school-student) fits perfectly with this type of model. Secondly, the weights, in both the first stage and second stage, is a very important question in this sample design. HLM models treat the weightings of the observations in the different stages in a natural way. The linear regression model has problems assigning appropriate weights to each observation.[25] Thirdly, the linear regression model, by not considering the random nature of the parameters, is not the most efficient procedure. Finally, in the field of analysis of educational results it is traditional to use this type of model.[26]

HLM models are characterized by a general specification

$$Y = X\beta + Zu + \epsilon$$

Where Y is the vector of anwers, X is the design matrix of the fixed effects and Z is the design matrix of the random effects u. The part of the specification associated to X is identical to a linear regression model. The random part Zu + ε has a variance-covariance matrix.

$$V\begin{pmatrix} u \\ \epsilon \end{pmatrix} = \begin{bmatrix} G & 0 \\ 0 & \sigma^2 R \end{bmatrix}$$

The random effects are not directly calculable but can be characterized by the elements of G or by the variance components. The total variance σ2, and the residual variance parameters appear in R. The structure of R enables the residual errors to be heteroscedastic or correlated.

However, this compact notation is not tradicionally used to describe the HLM models. The Raudenbusch and Bryk (2002) is the one which is normally used:

[25] Wöbmann's study (2003) shows to what extent the application of weights in a two-staged sample is complex, when regression techniques are used.

[26] See for example Martin et al. (2000).

$$Y_{ij} = \beta_{0j} + \sum_{q=1}^{Q} \beta_{qj} X_{qij} + \epsilon_{ij}$$

$$\epsilon_{ij} \sim N(0, \sigma^2)$$

$$\beta_{qj} = \gamma_{q0} + \sum_{s=1}^{Sq} \gamma_{qs} W_{sj} + u_{qj}$$

$$var(u_{qj}) = \tau_{qq} \qquad cov(u_{qj}, u_{q'j}) = \tau_{qq'}$$

First, we will analize the simplest model which will allow us to study the proportion that the variation between schools explains in the total variability. The specification of a path with random effects has the specification.

$$V\begin{pmatrix} u \\ \epsilon \end{pmatrix} = \begin{bmatrix} G & 0 \\ 0 & \sigma^2 R \end{bmatrix}$$

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

Table 3.4 contains the results of this estimation for the three subjects. In the first place, it is confirmed that both the averages as well as the variances are all very significant. The most important is the explanation of the variance. In mathematics the variation between schools is able to explain a proportion close to 28% compared to 23.5% which it is able to explain in the other two subjects.

To try to explain the variation between schools we will use two variables: the fact of whether the school is public or private and the average ISEI level of the school. Initially we will use the characteristic of the type of institution. In that case the specification of the coefficient variation by school would be

$$\beta_{0j} = \gamma_{00} + \gamma_{01} PUBLICA_j + u_{0j} \quad (1)$$

If the public school coefficient were positive, then this type of school would be more effective since it would have higher level of average results. Let's assume that the coefficient of one of the explanatory variables were also significant. For example, lets suppose that the test score depends on the socioeconomic indicador and that its coefficient depends on whether the school is public or private.[27]

[27] In several ocasions, the variables of the main equation are included in the differences regarding the school average (level 2) or the global average ("grand mean") although it is also common that the variables appear in their natural metric system. The decided location type affects the results interpretation.

$$Y_{ij} = \beta_{0j} + \beta_{1j}(ISEI_{ij} - \overline{ISEI_j}) + \epsilon_{ij}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}PUBLICA_J + u_{1j}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}PUBLICA_j + u_{0j}$$

In this case if the parameter γ11 were negative we could say that public schools are more equitable since the effect of socioeconomic level on the test scores would be lower.

Table 3.5 contains the estimation for each subject which includes a random effect for public school in the matrix Z. The results show considerable agreement between the determinants in maths and science, and some divergences compared to the results of the reading test. In the convergence the following significant effects appear: being born in the first and second term of the year, entering primary shool at age of 6, having more than 100 books at home, the parents having a higher socioeconomic level and the teacher having more than 5 years of experience. In science and maths being 9 years old at the time of taking the test is also significant, but not in the case of reading. Also, as is well known, the boys' results in science and maths are significantly better than those of the girls. The opposite happens in reading, though the differences are smaller than in the other two subjects.[28] In the case of the sciences, the fact that the subject teacher has a masters or a doctorate also improves the students' scores. All of the random effects are significant, with the exception of the public school in the case of reading.

Table 3.6 shows the results using the public school dichotomous variable and the ISEI average of each school as variables in Z. The results of this change are small. The only significant change is that of science, where if the student is older than 10 it has a negative effect.

Tables 3.7, 3.8 and 3.9 [29] present estimations with random effects in some of the coefficients of the explanatory variables of the model for maths, sciences and reading, respectively. The specification of the coefficients take the form of equation (2), in the case of the constant and the ISEI variable, and (3) in other cases even though the mayority of the coefficients are fixed.

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1}PUBLICA_j + \gamma_{q2}\overline{ISEI_j} + u_{qj} \quad (2)$$

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1}PUBLICA_j + \gamma_{q2}\overline{ISEI_j} \quad (3)$$

The results are generally similar to those obtained in Tables 3.6 and 3.7. In the case of maths the specification (3) applied to sex does not report any results of interest. More interesting is the application of (3) to the case of a large city. In the specification of tables 3.6 and 3.7 it is not significant. But when the public school dichotomous variable is included, the slope of the

[28] For a more detailed analysis of gender differences in reading see Martinez and Cordoba (in this volume).

[29] Some of the specifications are presented that summarize the most relevant findings obtained from models ranging from the general specification to the particular.

effect of a school in a big city becomes negative. However, a major part of the significance of the public school is due to the effect of the ISEI variable that has a positive impact on the score of a school in a big city. This exchange is not surprising given the strong negative correlation between the ISEI average by school (it does not matter if we calculate the ISEI using the occupations of fathers or mothers) and public school.

The application of (2) to the father's ISEI is also irrelevant. With respect to the constant, in some specifications the public school effect (obviously once controlled by the socioeconomic level) is significant and positive. However, this result is quite fragile. The result of applying (2) to the mother's ISEI coefficient is quite interesting. In public schools the effect of the mother's socioeconomic level on the test results is greater than in private schools. This would mean that public schools are less equitable than private if we consider the socioeconomic level measured from the occupation of the student's mother as a reference.

For the case of the science test the results are similar. Applying (3) to the coefficient of the student's sex does not provide any interesting insight. In the case of a school in a large city the result is similar to that observed in mathematics. For the coefficients modeled using (2), the constant and the mother's and father's ISEI, the results are also similar to the previous ones in maths. The only small difference is that, in the sciences, public schools never show a significant effect.

There are some differential effects in the reading tests, just as has been happening in all the previously performed exercises. The coefficient of the student's sex depends negatively on attendance to a public school. The entry to primary school at age 6 has a positive and significant effect while the teacher having over 5 years experience has no effect. Applying (2) to the mother's and father's ISEI coefficients do not provide any statistically significant results, unlike in maths and sciences. Finally, the coefficient of the effect of the school in a large city increases with the average of the socioeconomic level of the students of the school. Students who attend public schools, in the end, do not show a significantly different average than those who attend private school.

CONCLUSIONS

Recent studies show that the quality of educational results is more important than the extent of schooling for the explanation of economic development. Normally, quality is measured with reference to standardized knowledge tests. For example, Hanushek and Woessmann (2010) conclude that an increase of 25 points in PISA (equivalent to ¼ of standard deviation) would mean an increase of 115 billion dollars adjusted by the Parity of Purchasing Power (PPP) in terms of discounted future value until 2090. In the Spanish case, for example, it would represent 4.14 billion dollars, or approximately three years of the GDP.

For this reason it is particularly important to know the determinant factors of student scores on standardized knowledge tests. In particular it is important to know the influence of socioeconomic level and the type of school. Moreover, it is also interesting to know whether these factors are the same for all the analyzed subjects. Otherwise educational policy recommendations may depend on the type of subject.

The data analysis shows how some variables, such as the sex of the student, have a significant differential effect on unconditioned specifications and also when other relevant factors are conditioned. Others, however, lose their statistical significance when, for example, the socioeconomic status of the student's father or mother is included.

The results show that the proportion of variance between schools in the total variability is greater in mathematics than in sciences and reading. However, the results show considerable agreement between the determinants in maths and sciences, and some divergences compared to the results of the reading test. In the convergence the following significant effects appear: being born in the first and second term of the year, entry into primary school at the age of 6, having more than 100 books at home, the parents having a higher socioeconomic level and the teacher having more than 5 years of experience. In sciences and maths the student being 9 years old at the time of taking the test is also significant but this is not so in reading. Also, as is well known, the boys' results in sciences and maths are significantly better than the girls' results. The opposite happens in reading. In the sciences, whether the teacher has a masters or a doctorate also improves the students' scores.

In public schools the effect of the mother's socioeconomic status on the test results is greater than in private schools. This would mean that public schools are less equitable than private schools if we consider as a reference the socioeconomic level measured by the occupation of the student's mother. The coefficient of the effect of the school in a large city increases with the average of the socioeconomic level of the school's students. Finally, no robust effects of the differences of the averages of the scores of students who attend public schools instead of private are found.

Table 3.1 Average scores in the three tests

General results	Mathematics				Science				Reading			
	Average	S.D	t-stat	P value	Average	S.D	t-stat	P value	Average	S.D	t-stat	P value
TOTAL	482.426	2.914			505.150	2.960	38.479	0.0000	513.053	2.556	200.709	0.0000
Gender												
Boy	488.482	3.389			510.498	3.598			511.059	3.102		
Girl	477.234	3.005			500.869	2.718			515.624	2.560		
Difference	11.247	3.030	3.713	0.001	9.629	2.786	3.456	0.001	-4.566	2.398	-1.904	0.061
Type												
Public	476.015	3.613			498.419	3.707			506.585	2.489		
Private	494.722	4.773			518.060	4.411			525.424	5.253		
Difference	18.707	5.918	3.161	0.0022	19.641	5.601	3.507	0.0008	18.840	5.646	3.337	0.0013
Socioeconomic Status												
Level 1	480.586	2.466			504.223	2.703			510.629	2.371		
Level 2	494.588	5.101			516.470	5.764			529.112	4.573		
Level 3	504.247	5.914			523.406	7.887			526.890	8.165		
Level 4	520.671	3.459			543.171	4.084			550.507	3.295		
Difference	21.657	5.492	3.943	0.0004	20.522	5.521	3.717	0.0005	25.536	4.468	5.716	0.0000
Difference	31.316	6.181	5.066	0.0000	27.458	7.480	3.671	0.0005	23.314	7.465	3.123	0.0027
Difference	47.739	3.993	11.957	0.0000	47.223	4.193	11.262	0.0000	46.930	3.317	14.150	0.0000
Year of entry												
5 years old or before	479.195	3.152			500.974	2.992			507.177	3.277		
6 years old	493.332	2.798			516.407	3.342			524.668	2.490		
Over 6 years old	426.283	14.436			444.422	12.629			466.766	10.752		
Difference	14.137	3.201	4.417	0.0000	15.433	3.229	4.779	0.0000	17.492	3.011	5.809	0.0000
Difference	-52.912	14.294	-3.702	0.0006	-56.552	12.230	-4.624	0.0000	-40.411	10.412	-3.881	0.0002
Class size												
Less than 21	468.892	7.425			492.884	6.260			499.265	5.347		
Between 21 and 25	482.634	4.100			506.047	4.152			513.067	3.490		
More than 25	493.598	4.463			514.090	4.767			522.936	4.550		
Difference	13.743	8.639	1.591	0.1157	13.162	7.492	1.757	0.0830	13.803	6.635	2.080	0.0409
Difference	24.706	8.920	2.770	0.0070	21.205	7.850	2.701	0.0085	23.672	6.870	3.446	0.0009

Table 3.2. Average of the scores in the three tests: boys

Male students only	Mathematics				Sciences				Reading			
	Average	S.D.	t-stat	P value	Average	S.D.	t-stat	P value	Average	S.D.	t-stat	P value
Total	488.482	3.389			510.498	3.598			511.059	3.102		
Type												
Public	480.613	3.948			502.529	4.257			503.973	3.137		
Private	503.740	5.846			525.950	5.479			524.605	5.968		
Difference	23.127	6.852	3.375	0.001	23.421	6.499	3.604	0.001	20.632	6.600	3.126	0.003
Socioeconomic Status												
Level 1	486.485	3.359			508.957	3.742			509.046	3.187		
Level 2	496.695	8.808			516.581	9.779			524.972	7.562		
Level 3	510.877	9.200			528.156	11.468			523.884	10.326		
Level 4	526.573	4.657			548.825	5.217			547.610	4.121		
Difference	17.635	9.083	1.942	0.058	15.166	9.929	1.527	0.135	23.148	7.537	3.071	0.003
Difference	31.818	9.615	3.309	0.001	26.740	11.332	2.360	0.021	22.060	9.630	2.291	0.025
Difference	47.514	4.975	9.551	0.000	47.410	5.405	8.771	0.000	45.786	4.483	10.214	0.000
Age of entry												
5 years old or more	484.452	3.739			505.890	4.000			504.926	3.951		
6 years old	500.385	3.611			522.315	3.921			523.382	3.249		
Over 6 years old	430.919	21.174			446.029	18.811			465.550	17.110		
Difference	15.933	4.123	3.865	0.000	16.425	3.698	4.441	0.000	18.456	3.694	4.996	0.000
Difference	-53.533	21.159	-2.530	0.014	-59.861	18.241	-3.282	0.002	-39.376	16.756	-2.350	0.021
Class size												
Less than 21	473.419	7.861			496.940	6.548			493.465	6.188		
Between 21 and 25	489.081	5.055			511.754	5.021			512.742	4.231		
More than 25	500.950	5.374			520.507	5.541			521.449	4.962		
Difference	15.662	9.656	1.622	0.109	14.814	7.870	1.882	0.064	19.277	7.626	2.528	0.014
Diferencia Difference	27.531	9.816	2.805	0.006	23.567	8.463	2.785	0.007	27.984	7.523	3.720	0.000

Table 3.3. Average scores in the three tests: girls

Female students only	Mathematics				Sciences				Reading			
	Average	S.D	t-stat	P value	Average	S.D	t-stat	P value	Average	S.D	t-stat	P value
TOTAL	477.234	3.005			500.869	2.718			515.624	2.560		
Type												
Public	472.498	3.752			502.529	4.257			509.952	2.729		
Private	486.231	4.623			525.950	5.479			526.387	5.140		
Difference	13.733	5.775	2.378	0.020	15.188	4.488	2.768	0.007	16.435	6.687	2.890	0.005
Socieconomic Status												
Level 1	475.023	3.132			500.012	2.663			512.393	2.398		
Level 2	494.628	5.264			518.447	5.261			533.030	5.451		
Level 3	497.780	6.505			518.773	8.831			529.670	8.244		
Level 4	514.209	4.148			536.981	5.598			553.783	4.727		
Difference	27.026	5.641	4.791	0.000	26.916	4.894	5.500	0.000	27.141	5.580	4.864	0.000
Difference	30.178	7.068	4.270	0.000	27.241	8.749	3.114	0.003	23.781	7.965	2.986	0.004
Difference	46.607	4.863	9.584	0.000	45.449	5.910	7.690	0.000	47.895	4.835	9.907	0.000
Age of entry												
5 years old or before	473.816	3.817			495.949	3.162			509.731	3.471		
6 years old	486.839	3.181			511.281	3.756			526.139	2.844		
Over 6 years old	421.782	14.983			442.862	15.505			468.379	11.265		
Difference	13.022	4.085	3.188	0.003	15.332	4.460	3.438	48.301	16.408	3.914	4.192	0.000
Difference	-52.034	15.110	-3.444	0.002	-53.087	15.631	-3.396	0.001	-41.352	10.869	-3.805	0.000
Class size												
Less than 21	465.498	7.770			490.726	7.056			506.934	5.695		
Between 21 and 25	477.176	3.720			501.228	3.977			513.743	3.490		
More than 25	486.832	4.827			508.484	4.766			524.539	4.999		
Difference	11.678	7.850	1.488		10.502	8.020	1.309		6.809	6.760	1.007	
Difference	21.334	7.920	2.694		17.758	8.210	2.163		17.605	6.930	2.540	

Table 3.4 One-way model estimation with random effects

	Mathematics			Sciences			Reading		
	Coef.	Stand. Dev.	z	Coef.	Stand. Dev.	z	Coef.	Stand. Dev.	z
γ00	476.67		120.02	499.21		140.32	506.35		176.1
var(u0j)	1258.78	221.38		1101.23	204.13		981.44	124.20	
var(eij)	3252.21	85.33		3534.05	103.76		3176.26	79.81	
ρ	27.89%			23.75%			23.59%		

Table 3.5 Estimation model I

	Mathematics		Science		Reading	
	Coef.	z	Coef.	z	Coef.	z
Students Charateristics						
Demographic						
Boy	10.1748	4.37	9.1059	4.04	-6.2008	-3.27
Age= 9 years old	50.1494	3.56	40.0926	3.37	26.2998	1.65
Age= 10 years old	21.8469	1.55	11.6923	1.06	8.5500	0.55
Age over 10 years old	-21.9625	-1.25	-32.8837	-2.13	-28.5458	-1.66
Term of birth= first	39.9692	7.64	44.3943	8.68	31.8804	7.86
Term of birth = second	15.1853	4.74	16.1539	4.36	14.2162	4.43
Term of birth = third	2.7029	0.84	3.2592	0.93	1.2922	0.41
Education						
Pre-school: 3 years old or more	5.2661	1.92	3.1306	1.06	3.7941	1.69
Age of entry to primary school= 6	5.3133	2.07	5.9731	2.29	8.1043	3.44
Age of entry to primary school>6	-16.7221	-1.12	-1.5759	-0.10	0.6723	0.07
Socioeconomic						
Father's ISEI	0.3289	4.01	0.3130	3.95	0.2475	2.95
Mother's ISEI	0.4504	5.69	0.4385	5.34	0.3448	5.14
More than 100 books	18.6928	7.60	18.2829	6.90	17.7738	7.42
School characteristics						
Public	-2.5135	-0.37	-0.1145	-0.02	-1.6736	-0.26
In a big city	0.1165	0.02	-0.9086	-0.14	-2.1631	-0.31
In a town	-1.8524	-0.29	8.0195	1.39	6.8414	1.26
Teacher characteristics						
Male	-2.3330	-0.41	-2.0035	-0.42	-2.5740	-0.79
Major in the subject	-2.2262	-0.40	-2.6010	-0.50	2.9901	0.78
Diploma or Graduate	-3.4442	-0.29	1.8271	0.22	-4.6698	-0.52
Master or Doctorate	19.8249	1.61	18.8878	2.02	7.0777	1.00
Age between 20 and 30	1.2696	0.11	13.0724	0.98	6.5331	0.60
Age between 30 and 50	-0.2784	-0.07	0.1101	0.03	0.2830	0.06
Over 5 years of experience	15.3782	2.45	15.3130	1.96	11.3771	1.69
Constant	390.1844	19.04	403.6888	24.11	445.1900	22.31
Random effects: Standard deviation						
Public school	16.5505		14.7816		0.0001	
Constant	21.0814		19.4132		23.7900	
Residual	52.2533		53.1025		52.1672	

Table 3.6 Estimation model II

	Mathematics		Science		Reading	
	Coef.	z	Coef.	z	Coef.	z
Student characteristics						
Demographic						
Boy	11.1571	4.74	9.1132	4.05	-6.2012	-3.27
Age= 9 years old	48.7895	3.24	40.0031	3.36	26.2868	1.65
Age= 10 years old	18.1624	1.21	11.6496	1.05	8.5456	0.55
Over 10 years old	-21.6244	-1.11	-32.5866	-2.11	-28.4201	-1.65
Term of birth= first	42.8372	8.31	44.3888	8.68	31.8765	7.86
Term of birth= second	15.1366	4.53	16.0916	4.36	14.1851	4.42
Term of birth = third	2.1238	0.64	3.1964	0.91	1.2740	0.40
Education						
Pre-school: 3 or more years	4.7645	1.77	3.1886	1.08	3.7852	1.69
Age of entry to primary= 6	5.1417	2.02	5.9956	2.30	8.1221	3.44
Age of entry to primary>6	1.1234	0.08	-1.5392	-0.10	0.6522	0.06
Socioeconomic						
Father's ISEI	0.3022	3.44	0.3105	3.92	0.2463	2.93
Mother's ISEI	0.4106	4.8	0.4388	5.36	0.3443	5.13
More than a 100 books	15.8391	6.11	18.2933	6.91	17.7947	7.43
School characteristics						
Public	2.9497	0.52	0.8403	0.16	-0.9304	-0.15
In a big city	-1.1671	-0.18	-2.8618	-0.46	-2.9476	-0.42
In a town	1.4755	0.26	7.9208	1.41	6.7710	1.26
Teacher characteristics						
Male	-2.5044	-0.47	-1.4772	-0.32	-2.5641	-0.79
Major in the subject	-4.2071	-0.85	-2.9340	-0.56	2.6719	0.70
Diploma or Graduate	-4.0433	-0.35	1.9933	0.24	-4.8099	-0.55
Master or Doctorate	17.3909	1.54	18.4211	2.06	6.7295	0.94
Age between 20 and 30	9.0693	0.96	15.2245	1.17	7.1341	0.65
Age between 30 and 50	0.5737	0.15	0.2272	0.06	0.1055	0.02
Over 5 years of experience	17.8071	3.22	15.5477	2.03	11.2885	1.67
Constant	378.4389	18.1	402.7731	24.5	444.9265	22.40
Random effects: Standard deviation						
Public school	13.9859	11.93	17.3497	4.00	0.0000	0.00
Average father's ISEI	0.4905	0.11	0.4469	0.07	0.3005	0.16
Constant	0.0004	0.01	0.0003	0.00	20.6710	3.86
Residual	51.7527	1.02	53.0912	0.93	52.1651	0.75

Table 3.7 HLM models for the Maths scores

	Coef.	z	Coef.	z	Coef.	z
Student characteristics						
Demographic						
Boy						
constant	11,00	4,28	11,80	4,77	5,36	0,31
Public					-5,92	-1,06
Average ISEI					0,23	0,62
Age= 9 years old	52,29	3,49	37,85	9,29	45,72	2,89
Age= 10 years old	21,00	1,41			14,88	0,92
Over 10 years old	-25,95	-1,36			-31,34	-1,67
Term of birth= first	46,55	9,35	51,87	10,96	45,30	8,45
Term of birth = secong	17,81	5,60	18,03	6,07	16,05	4,49
Term of birth= third	3,69	1,20	5,17	1,73	3,55	1,00
Education						
Pre-school: 3 years or more	6,72	2,45	8,02	3,02	6,98	2,51
Age of entry into primary= 6	4,12	1,63			3,37	1,27
Age of entry into primary>6	-2,21	-0,15			2,91	0,21
Socioeconomic						
Father's ISEI						
constant	0,74	1,18	0,34	3,91	1,22	1,95
Public	-0,21	-1,16			-0,19	-1,02
Average ISEI	-0,01	-0,60			-0,02	-1,46
Mother's ISEI						
constant	0,42	5,17	0,41	0,93	0,41	5,09
Públic			0,39	2,74		
Average ISEI			0,00	-0,49		
More than 100 books	16,77	5,65	14,88	5,49	15,69	5,71
Shcool characteristics						
In a big city						
constant	17,43	1,95	-66,91	-2,43	-60,334	-1,85
Public	-30,69	-2,78	-16,93	-1,80	-20,19	-1,84
Average ISEI			1,90	2,93	1,79	2,45
In a town	5,04	0,83			2,88	0,49

Table 3.7. HLM models for Maths scores (continuation)

	Coef.	z	Coef.	z	Coef.	z
Teacher characteristics						
Male	-3,63	-0,65			-4,22	-1,10
Major in the subject	-2,44	-0,48			-1,98	-0,45
Diploma or Graduate	0,91	0,08			-2,03	-0,15
Master or Doctorate	13,35	1,26			13,19	1,48
Age between 20 and 30	4,45	0,41			2,87	0,25
Age between 30 and 50	-1,20	-0,31			-0,30	-0,08
Over 5 years of experience	17,98	2,75	13,98	2,99	15,66	1,83
Constant						
cons	323,88	8,58	381,00	13,37	340,86	8,44
Public	25,41	2,26	-1,70	-0,18	24,30	2,00
Average ISEI	0,83	1,13	0,12	0,18	0,63	0,72
Random Effects: Standard Deviation						
Constant	26,91	<0,001	23,5			
Father's ISEI average	0,18	0,01	0,1			
Residual	52,25		52,3			

Table 3.8. HLM model for Science scores

	Coef.	z	Coef.	z	Coef.	z
Student Characteristics						
Demographic						
Boy	8,9300	3,67				
constant			8,7200	1,40	9,8800	4,10
Public			-6,7600	-1,20		
Average ISEI			0,1100	0,27		
Age=9 years old	38,8200	4,08	39,5700	4,19	35,9700	8,91
Age= 10 years old	10,0200	1,06	10,9800	1,16		
Over 10 years old	-42,6900	-2,67	-40,9600	-2,54		
Term of birth = First	45,9200	8,57	45,4300	8,48	52,3800	10,67
Term of birth = second	16,1000	4,02	15,9300	3,98	17,5100	5,15
Term of birth= third	4,1600	1,09	4,2100	1,11	5,9600	1,88
Education						
Pre-school: 3 or more years	4,3900	1,54	4,4600	1,59	5,8700	2,11
Age of entry into primary= 6	5,6700	1,90	5,2800	1,79		
Age of entry into primary>6	-1,1900	-0,06	-1,2600	-0,07		
Socioeconomic						
Father's SIIC						
constant	0,8800	1,48	1,0400	1,74	0,3500	4,12
public	-0,2000	-1,22	-0,1700	-1,08		
average ISEI	-0,0100	-0,85	-0,0100	-1,18		
Mother's ISEI						
constant	0,4400	5,13	0,4400	5,11	0,4300	0,10
Public					0,35	2,43
average ISEI					0	-0,35
More than a 100 books	17,7900	5,83	17,8700	5,90	16,0700	5,72
School characteristics						
In a big city						
constant	-4,3200	-0,68	-94,1200	-3,28	-104,2900	-3,69
public			-6,3100	-0,61	-3,37	-0,34
average ISEI			2,3900	3,59	2,52	3,79
In a town	7,1200	1,21	7,8100	1,40		

Table 3.8. HLM models for science scores (cont.)

	Coef.	z	Coef.	z	Coef.	z
Teacher characteristics						
Male	-2,7600	-0,55	-3,0300	-0,62		
Major in the subject	-2,7600	-0,54	-1,1500	-0,23		
Diploma or Graduate	3,1400	0,34	3,0800	0,42		
Master or Doctorate	14,7200	1,68	15,8900	1,57		
Age between 20 and 30	15,1100	0,99	12,4400	0,91		
Age between 30 and 50	-0,8600	-0,21	-0,8400	-0,20		
Over 5 years of experience	18,5200	2,02	16,7400	2,07	10,6600	5,68
Constant						
	374,0200	11,91	398,5800	11,70	445,9500	15,91
public	7,7700	0,91	13,6100	1,41	-12,2300	-1,48
average ISEI	0,5900	0,75	-0,1500	-0,19	-0,6000	-0,87
Random effects: Standard Deviation		p-val				
Constant	23,2400	<0.001	20,7100	<0.001	22,87	<0.001
Father's average ISEI	0,0800	0,21	0,0600	0,21	0,0800	0,17
Residual	53,8300		53,7400		54,25	

Tabla 3.9. HLM models for Reading scores

	Coef.	z	Coef.	z	Coef.	z
Student characteristics						
Demographic						
Boy						
constant	-5,6800	-2,13	-5,6600	-2,20	15,6200	0,95
public					-9,4200	-1,86
average ISEI					-0,3900	-1,09
Age= 9 years old	26,5800	1,31	26,8700	1,41	27,6600	1,45
Age=10 years old	8,2800	20,39	8,4000	0,43	9,2300	0,47
Over 10 years old	-28,1200	-1,22	-28,5300	-1,33	-26,7700	-1,25
Term of birth = first	31,9800	5,38	32,2600	6,01	31,7500	5,93
Term of birth = second	13,0900	3,31	13,2100	3,06	12,9300	2,97
Term of birth= third	-1,3500	-0,34	-1,3500	-0,32	-1,4000	-0,33
Education						
Pre-school: 3 years or more	3,2400	1,05	3,1600	1,01	3,1400	1,07
Age of entry into primary= 6	6,8500	2,32	6,9000	2,22	6,6400	2,14
Age of entry into primary>6	-5,2100	-0,35	-5,2400	-0,32	-4,6300	-0,26
Socioeconomic						
Father's ISEI	0,3000	0,41	0,2400	2,21	0,3600	0,49
constant	-0,1600	-0,78			-0,1400	-0,74
public	0,0000	0,05			0,0000	-0,05
average ISEI						
Mother's ISEI	0,3000	3,38	-0,3800	-0,77	0,3000	3,71
constant			0,1300	0,94		
public			0,0100	1,37		
average ISEI	16,1300	5,31	15,9700	4,96	16,3800	5,19
More than a 100 books						
School characteristics						
In a big city						
Constant	-8,7700	-1,21	-8,4900	-0,96	-114,6700	-2,79
public					1,4200	0,09
average ISEI					2,6500	2,98
In a town	6,0500	0,91	6,1400	0,88	7,7100	1,19

Table 3.9. HLM models for Reading scores (cont.)

	Coef.	z	Coef.	z	Coef.	z
Teacher's characteristics						
Male	-0,7200	-0,18	-0,6200	-0,15	-1,4500	-0,35
Major in the subject	2,3200	0,45	1,9800	0,39	3,5600	0,69
Diploma or Graduate	1,5600	0,11	1,4200	0,11	1,2000	0,09
Master or Doctorate	5,4600	0,59	5,8700	0,62	6,6300	0,69
Age between 20 and 30	9,4200	0,77	9,0100	0,58	8,1600	0,59
Age of 30 and 50	-0,5200	-0,11	-0,6800	-0,12	-0,0500	-0,01
More than 5 years of experience	14,5900	1,58	14,2600	1,56	13,4600	1,62
Constant						
	407,9300	10,09	432,9800	12,17	423,2800	11,35
public	9,5100	0,92	-0,8800	-0,08	14,9800	1,36
average ISEI	0,6900	0,94	0,2200	0,32	0,1400	0,18
Random effects: Standard deviation		p-val				
Contant	17,2100	<0.001	17,6600	<0.001	16,9700	<0.001
Father's average ISEI	0,1200	<0.001	0,1500	<0.001	0,1600	<0.001
Residual	52,4200		52,4000		52,3300	

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APPENDIX I: NOTES ON WEIGHTS

There are many variables that include the different components of the final weights assigned to each observation or to each school. The definitions are as follows:

WGTFAC1: School weights

WGTADJ1: adjusted school weights (by participation, see TIMSS 2007 TECHNICAL NOTE chapter Sample design in TIMSS and PIRLS)

WGTFAC2: class weights

WGTADJ2: adjusted class weights

WGTFAC3: students weights

WGTADJ3: adjusted student weights

SCHWGT: weight designed for school –level analisys

TCHWGT, weight designed to use the background of teachers in student-level analysis based on TOTWGT. MATWGT, SCIWGT are weights if only math teachers or only science teachers are used.

TOTWGT is the weight for the individual analysis of the students in a particular country. Raises the sum of all weights to the total of students in that educational level (fourth grade of Primary in Spain)

SENWGT: weight for individuals used to compare countries. This corresponds to 500 students in each country.

HOUWGT: weight that is used if the statistical program can not work with weights that increase the total number of students.

Following the definition of the chapter from TIMSS 2007 Technical guide on sampling, the product of the weights of each level (school, classroom, individual) adjusted by their participation produces weights for the student level analysis.

TOTWGT= WGTFAC1*WGTADJ1*WGTFAC2*WGTADJ2*WGTFAC3*WGTADJ3

The definition of these weights is in the corresponding chapter of the TECHNICAL NOTE TIMSS 2007. Joncas and Foy (2012) describe the weights for the 2011 sample which basically follows the same pattern as the one previously used.

TOTWGT_P: Students' weights PIRLS individual analysis.

SCHWGT_P: School weights PIRLS

Chapter 4

On the Impact Of Pre-school Attendance On Primary School Results

ON THE IMPACT OF PRE-SCHOOL ATTENDANCE ON PRIMARY SCHOOL RESULTS

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ABSTRACT

In this paper we analyze the impact of pre-school attendance on the Primary school scores in Reading, Maths and Sciences of a sample of Spanish students. The results we obtain show that attending pre-school has a positive effect on primary scores, especially in Reading: those who attended pre-school for at least 3 years obtain close to 16 points more than the rest, which is around 3% higher than the Reading average. We also find that attending pre-school has a positive impact especially among those students with lower family education level (their average is around one third of the standard deviation higher than the average observed in the Reading test). Furthermore, we find that attending pre-school means that students who were born in the last terms of the year increase their chances of getting high scores, while we get smaller probabilities of being below the observed first quartile of scores in the three analyzed subjects, both for children with non-university-educated parents as well as for children born in the second semester of the year.

INTRODUCTION

Given the growing empirical evidence on the relationship between education level and economic growth, the education results of students is becoming a subject of interest.[1] Furthermore, there is also broad knowledge of the possible determinant factors of academic performance. The literature on this subject gathers these factors into three broad categories: individual student characteristics, certain factors outside the education system (socio-familiar

[1] There is extensive literature on the relationship between education and economic growth. See, among others, Hanushek and Kimko (2000), Barro (2001) and Acemoglu (2009).

factors) and education received within the education system (school characteristics). [2] This last factor encompasses aspects such as the amount of resources invested, on the one hand, and the institutional design of the education system on the other (entry age, number of class hours, etc.). While there is some published evidence on the effects that economic resources have on student performance, still little is known about the effect of certain institutional aspects. In this paper we focus on one of them that has huge importance (see Heckman (2006), among others): that of pre-school education.[3]

The fact that cognitive and non-cognitive skills acquired during the period of pre-school (ie: from birth to five or six years old) are one of the principal determinants of the individual's productivity in later stages is a very widespread finding in the literature (see Becker (1964), Heckman (2006)). As a consequence of this, the performances of educational investment at early ages are higher than those obtained in later stages, to the extent that they can be recovered over a longer period of time (Heckman (1999)). If we also consider that investments in human resources at the present time are complementary to investments made in the future ("learning begets learning" according to Carneiro and Heckman (2003)), then we can conclude that a correct design of educational policies has to go through a proper understanding of the role of pre-school. Firstly, investment in education at this stage is an appropriate strategy in terms of costs for the public sector: the spending on pre-school in the short term can be compensated by the reduction of spending on programmes designed to meet special needs education and similar programmes. Secondly, in the long term we may also manage to reduce social spending such as unemployment benefits, health policies, etc.

The aims of this paper are as follows, firstly, to estimate the impact of the student's attendance to pre-school Education (and its duration) on the scores obtained in Language tests (PIRLS), Maths and Sciences (TIMSS) from a sample of Spanish students in the fourth year of Primary Education for the 2010-2011 academic year. Secondly, we analyze whether this possible effect of attending pre-school on students' performance in primary school depends on the student's family socioeconomic level and, if so, how.

Most of the available empirical evidence on this matter is focused on analyzing the impact of early intervention especially designed to help children with higher risk of social failure, particularly those who belong to the most disadvantaged families, with fewer resources to invest in the education of their children. Thus, most studies confirm the effectiveness of such policies (see Barnet (1992), Currie (2001), Garces, Thomas and Currie (2002), Blau and Currie (2006), among others). However, the effect of other types of more universal intervention policies at early ages is not so obvious from an empirical point of view. In fact, there is some evidence that separating children at this age from their mothers while they are working has negative effects on child development (Baker et al. (2008) and Ruhm (2004)). As well as

[2] References are numerous, from the original Coleman Report (Coleman et al. 1966) to more recent studies such as Heckman (2006).

[3] García-Montalvo (2012) analyzes other institutional factors such as the type of school: public versus private.

analyzing the effects of pre-school attendance on the students' non-cognitive results, the limited literature on the analysis of universal intervention policies at an early age has been focused on studying their impact on variables such as the probability of repeating a year, the student's preparation for the entry into Primary Education, the mother's decision to participate in the labor market, or the years of education completed by the student and dropout rates in Secondary Education. So, Cascio (2004) finds that attending pre-school Education reduces the likelihood of student repeating years throughout the course of their academic life. Magnuson et al. (2007) find that students who attended pre-school showed better skills on entry to primary. Baker et al. (2008) also find that the expansion of childcare programs increased the participation in the labor market of married women. Berlinski et al. (2008) find very small effects of pre-school attendance on the number of years of education completed by the student as well as on the school dropout rates, although the size of the effect increases the longer the period of time. The work closest to ours is that of Berlinski et al. (2009), which investigates the effect of an expansion of public pre-school Education on the subsequent academic results in primary school in Argentina. However, the database used by Berlinski et al. (2009) lacks information on pre-school attendance at an individual level. Thus, to identify the effect of attending pre-school on school results, they use the variation in the offer of school places between regions and groups between 1993 and 1999.

Therefore, our paper expands on this literature in at least three aspects. Firstly, regarding the identification strategy used when individual data of pre-school attendance is available. Secondly, through the analysis, not only it is studied the impact of attendance or non-attendance of pre-school, but also its duration on the results in primary. Finally, in this paper we analyze the distribution of academic results under different scenarios: attendance and non-attendance of pre-school, and we compare it according to several criteria. This is crucial, since in the evaluation of this type of interventions the previous literature has focused mainly on average impacts.

The PIRLS-TIMSS 2011 Programs, besides carrying out tests in Language (PIRSL), Maths and Sciences (TIMSS), also provide a very extensive body of information about the student learning context through questionnaires answered by students, parents, teachers and school heads. With these variables, we study the effect it has on the scores of the sample students, the variables of interest related to the student's pre-school attendance and its duration, taking into consideration the possible additional effect on the scores of those students of the rest of the determinants that relate to the student's socio-demographic characteristics, educational context, etc.

To do this, we will perform an econometric analysis of the exam scores in Language, Maths and Sciences of the students in our sample, using different statistical techniques. Firstly, we analyze the average grade in each discipline conditioning the analysis to a broad set of explanatory variables related to the students' own characteristics, those of their family, teacher and school. Secondly, we will study the specific effect of the variables related to pre-school attendance, allowing the possibility of different effects depending on the educational level in the home and the child's term of birth. Finally, we will study, through a discrete choice

of binary models, whether these variables related to pre-school attendance have a different effect throughout the distribution of observed grades in our sample, ie: we will study whether these variables exert a different influence on the probability of getting a very low (below the first quartile) or a very high grade (over the third quartile).

Our results show that the average grade in any of the three analyzed disciplines is higher for children whose parents have a high education level, who show a high skills level and who are 10 years old or less when taking the test. We also find that grades are higher for children in homes with better resources in terms of possessions related to high purchasing power (internet connection, number of books, etc.). Finally, we also find that children in large schools located in areas of medium or high income have better grades in all three analyzed disciplines.

Regarding pre-school attendance, both the descriptive analysis and the econometric estimations carried out show us that attending pre-school has a positive result on the scores, especially in the discipline of reading: those who went to pre-school for at least three years get about 16 points more, which is about 3% above the average in reading. The average effect of these variables, however, is not significantly different from zero in maths and sciences. We also find that attending pre-school has a positive impact, especially among those students with a lower family education level (their average grade is around one third of a standard deviation higher than the average grade observed in the reading test). In other words, this positive effect that attending pre-school has in reading is basically due to its strong and significant effect in families where no member has university education, so that we can conclude that pre-school attendance is mainly benefitting middle and low income families. Furthermore, we find that it is the students born in the third or fourth term who most benefit from having attended pre-school for 3 years or more. Finally, we find that pre-school attendance reduces the probability of getting a low grade (below the 25th percentile) in the three disciplines. At the same time, we find that the probability of getting a grade above the third percentile is very positively correlated to pre-school attendance for three or more years for those students born in the second semester of the year.

The rest of the paper is organized as follows. In Section 2 we briefly describe the databases and variables used in the analysis. Section 3 focuses on the analysis of pre-school Education in Spain in general during the period under study. Section 4 shows the model and methodology used in the paper. Section 5 shows the results obtained and Section 6 presents our main conclusions.

DATA AND DESCRIPTIVE ANALYSIS

Databases

In this paper we use the TIMSS-PIRLS 2011 database for Spain. This database contains data from a sample of students enrolled in 4th year of primary school during the 2010-2011 school year. The data consists, on one hand, of the results of standardized tests of Language (PIRLS), Maths and Sciences (TIMSS) performed on 8,000 and 4,000 students, respectively. However, there are some autonomous regions which are over-represented in the sample, so from now on we will always correct our results using the population weights provided in the survey. On the other hand, this database also includes a set of extensive information about the context of student learning through the questionnaires completed by students, parents, teachers and school heads.

Additionally, we complete the previous database with data from the Ministry of Education regarding pre-school education in Spain (number of centers that offer this type of education) and non-university education spending during the period from 2001 to 2010, disaggregated by Autonomous Region. We also use data on the population with ages understood to be between 0 and 5 years in this same period, by Autonomous Region, from the National Institute of Statistics (INE) to calculate the aggregate variables related to pre-school attendance that will be described in detail later.

To avoid confusion the next section focuses on the PIRLS-TIMSS database. The data used from the MEC and INEE will be described in Appendix III.

Finally, as far as the methodological details related to the database used are concerned, we have to warn that, as other authors have already noted, both in PIRLS and TIMSS there are a significant number of variables with "missing values".[4] Specifically, this problem is quite severe in some variables of interest in our paper, such as the educational level of the parents or students' pre-school attendance. Because leaving out students with “missing values” in any explanatory variable would considerably reduce the sample size, eliminate information contained in the other explanatory variables and would introduce bias in the analysis if the "missing" observations were not random, in this paper we have decided to perform imputations of values (see Appendix II) based on the multiple imputation methodology developed by Rubin (1987) and Schafer (1997). [5]

[4] See Woesmann (2003), Bedard and Dhuey (2006) and Ammermueller and Pischke (2009), among others.

5 The variables that required imputation of values "missing" and the number of cases in which it has been necessary to make that imputation are shown in Appendix II.

Variables used

We begin by considering a series of factors as possible determinants of the scores obtained by the student. In this way, we group these factors into the following categories: individual student characteristics; socio-familiar (ie, particular factors outside the education system); and school characteristics (ie: particular factors within the education system). Table 4.1 in Appendix I shows a summary of the main descriptive statistics concerning the individual and socioeconomic characteristics of the student. The last three columns of this table show the scores in Language, Maths and Sciences according to the variables considered. Specifically, the variables analyzed in the first category include the students' gender, age, the term of birth and a variable that we consider being a proxy of their skill, and that indicates whether the students receive help from their parents in doing Maths homework (question answered by the students' parents). As we can see in this table, girls score higher than boys in Language, but worse in Maths and Sciences. In terms of age, most students from the sample are between 9 and 10 years old, which is the reference age for students who are in the 4th grade of Primary. We can see that the scores in these three subjects, both for students who are younger than 9 years old as well as, above all, for those who are over than 10 years old, are lower than the scores of students who are 9 or 10 years old. [6] However, we see that the score in the three disciplines is lower the later the term of birth. This result confirms the existing empirical evidence on the impact of this variable on the student's score.[7] Finally, we observe that the majority of the students in the sample receive help from their parents in doing Maths homework (over 85%). Regarding the scores obtained by these students, we see that they get poorer results in the three disciplines than those students who do not receive help.

Regarding the socioeconomic variables, in this paper we firstly consider the level of average income of the area where the school is located (question answered by the school head) the education level of the father and mother of the student, and finally certain household possessions, such as the number of books (typical indicator of cultural level) as well as internet connection. We see that about 75% of the students of the sample are in schools located in areas with an average income level, and that those who are in schools with a high income level get better scores than the rest. Moreover, we see that over half of the students in the sample have a father or mother with a level of studies of Secondary education or lower, and that the average educational level of the mothers of the students in the sample is higher than that of the fathers. In Table 4.1 we see that the higher the education of the father/mother, the better the results of the student. The household possessions as well as the number of books or internet availability also influence student scores. So, the larger the number of books at home,

[6] Students over 10 years old may be those repeating a year.

[7] Recent literature breaks down the effect of month of birth on student results into two factors: the age when taking the test and the age of entry into primary school. Thus, Crawford, Dearden and Meghir (2010) find that the age when taking the test is a more important factor than the age of entry. Black, Devereux and Salvanes (2011) find that the age of entry has a small but negative effect on the student's education results. However, in a similar way to the previous ones, they find that the age of the student during the test has a larger effect.

the better the student scores. Similarly we see that students who have internet at home have better scores than those who do not.

Finally, we group the school variables into three categories according to the source or the questionnaire, from which we extracted the particular data, ie: the one answered by the head of the center, the one answered by the teacher or the one answered by the student's parents. Regarding the variables provided by the head of the center, here we focus on the type of school (public or private), whether it is located in an urban area (or residential) or rural (village or remote rural area) and the size of the center measured by the number of students in fourth grade (we consider the school to be large if it has 75 students or more in 4th grade of Primary, which is the distribution mode value as well as the 75th percentile value). Table 4.1 shows the main descriptive statistics for the school characteristics as well as the students' scores according to these characteristics. We see that over half of the sample students study at public schools, in urban areas with medium income levels. Regarding the effect of these variables on the test results, we find that students who are in private schools get higher scores than those who study in public schools. Students from schools located in urban areas score higher than those in rural areas, and finally those students in schools with a higher number of students in Primary get higher scores. Moreover, in terms of the variables included in the teachers' questionnaire, we focus on the their characteristics such as gender, education level, whether they have specific training in pre-school or Primary school teaching, and also a variable related to the extra effort they put into their work (which is measured by the frequency which with they correct the students' homework, and give feedback on those corrections, in all three subjects). As for the characteristics of the sample teachers we see that the majority are women, between 30 and 50 years old and with over 20 years of experience. Over 80% of teachers in the sample have specific training in pre-school and Primary Education. Finally, the majority say that they put extra effort into the three subjects of Language, Maths and Science. As for the results of the test, we find that students who have a male teacher get better results in all three subjects than those who have a female teacher. Furthermore, we see that the older the teacher, the better the student scores. In general, scores also improve with the experience of the teacher. And in the same way we also see that the higher the educational level of the teacher, the higher the student scores in Maths or Sciences, but not in Reading. Finally, the teachers who have specialized training have students with similar results to those who do not have this training.

PRE-SCHOOL EDUCATION IN SPAIN

The Spanish educational system nowadays and during the years in which the students of the PIRLS-TIMSS 2011 sample were between 0 and 6 years old (ie: between the years of 2000 and 2010) contemplates 6 years of non-compulsory pre-school Education divided into two stages:

the first, from 0 to 3 years, which is usually paid, and the second, free of charge, from 3 to 6 years old. [8] Next, we show a series of variables related to the sample students' participation in pre-school level. More specifically, we have information on whether or not the student attended pre-school Education, and for how long, as well as the students' age of entry into Primary Education. These variables are included in the questionnaire completed by parents. Table 4.2 shows us some descriptive statistics on pre-school attendance in Spain, as well as the scores obtained on each of the subjects according to the student characteristics. Firstly we see that the average age of entry into Primary is between five and six years old, and the best scores are obtained by the students who started Primary school at 6 years old. [9]

Secondly, we see that just over 3% of the students in the sample have not attended pre-school any year, almost 8% have attended for a year, over 23% went for two years and finally almost 66% have attended pre-school Education for three years or more. In the case of Reading, the student's scores improve the more years that they attended pre-school, the difference being greater between the students who have not attended any year and those who went for 3 or more years.

Figure 4.1 offers us additional evidence about the relationship between pre-school attendance and Primary school results. In this case we add pre-school attendance data for at least three years, and the average scores of the Autonomous Region and we show the relationship between these two variables. We show this relationship for each of the three subjects. In these graphs we can see that there is a positive relationship between these variables for the three cases analyzed. That is, those Autonomous Regions with a higher percentage of students who attended at least three years of pre-school show better results in all three subjects, which is consistent with the results obtained in the descriptive analysis.

Next, we analyze the characteristics of students who attended pre-school for zero, one, two or three or more years. Thus, Table 4.3 shows the individual and socioeconomic characteristics of students who attended pre-school for zero, one, two or three or more years. Firstly, we see that there are no significant differences in the number of years the student has attended pre-school Education depending on their sex. As for the term of birth, we also see that there is no very differentiated behavior pattern although we can highlight the fact that students who were born in the 4th term of the year show pre-school attendance rates for at least three years lower than those who were born in any other term, and a one year pre-school attendance rate higher than the rest. We also see that among those students who do not receive help from their parents to do Maths homework, over 70% attended pre-school

[8] In 2008 the Ministry of Education initiated a plan in order to promote pre-school Education 0-3, known as "Educa3", which aimed at creating new school places for children of 0-3 years. Unfortunately we can not evaluate that program in terms of its impact on the results of students in Primary school in the sample PIRLS-TIMSS 2011 due to a lack of detailed information on educational attendance for a period over three years by the students. See Felgueroso (2012) for a preliminary analysis of this program.

[9] See Note 6 on the existing empirical evidence on the impact of age of entry on the student's academic performance.

Education for three years or more, five percentage points higher than that corresponding to students who do receive help from their parents.

Secondly, we see that there are large differences in the number of years of pre-school attendance depending on the socioeconomic characteristics of the student, specifically, the education level of the father and the mother. For example, while over 76% of students with a father who has university education attended pre-school for three years or more, this percentage only reaches 56% among those students with a father with a level of studies lower than Primary. [1] The difference between these same percentages is even greater when we compare students with a university-educated mother and students with a mother who has a level of studies lower than Primary. In the same way, while only 2% of students with a university-educated father didn't attend any year of pre-school Education, this percentage doubles when we refer to students whose father has studies lower than Primary. These differences are maintained when we compare percentages of pre-school attendance according to the number of books at home. The more books at home, the greater is the percentage of pre-school attendance for at least three years, and the lower the percentage of non-attendance. Similarly, students in homes that have internet have a higher percentage of pre-school attendance for at least three years than students in homes without internet.

The analysis so far focuses on the average effects on educational results in Primary among those students who did not attend pre-school and those who did so for at least three years. Next, we complete this approach by studying the distribution of results in each of the subjects. Figure 4.2a illustrates the accumulated score distribution function in each of the three subjects y_m, with *m* = Reading, Mathematics and Sciences, for two groups of students: those who went to pre-school for at least three years, and denoted by $F_S(y_m)$, and those who went to pre-school for a shorter period, and denoted by $F_N(y_m)$. So we can see that, for any of the three subjects, the distribution function of results of those students who went to pre-school for at least three years shows first-order stochastic dominance over the distribution function of results of those students who went to pre-school for a shorter period, i.e. $F_S(y_m) FOSD\ F_N(y_m)$. [2] In other words, the probability of getting a score equal to, or lower than, any of the possible distribution values in the three subjects is always equal or lower for those students who attended pre-school for three years or less compared to those who went for three years or more. Figures 4.2b and 4.2c show the function of accumulated distribution of the scores in the three subjects for these two groups of students, but conditional on having a father or mother with university education (Figure 4.2b) and parents with non-university

[1] Felgueroso (2012) found similar results when comparing education rates of children between 0 and 5 years for mother's educational level for the year 2009.

[2] We say that $F_S(y_m) FOSD\ F_N(y_m)$ if $F_S(y_m) \leq F_N(y_m)$ for any $y_m \in [\underline{y}, \overline{y}]$ and $F_S(y_m) < F_N(y_m)$ for some $y_m \in [\underline{y}, \overline{y}]$,, where $\underline{y}$ and $\overline{y}$ represents the lowest and the highest respectively, of subject *m*.

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studies (Figure 4.2c). As we can see, in all cases, the distribution function of results of those students who went to pre-school for over three years stochastically dominates the distribution function of those who attended for a shorter period. This result holds for the three subjects analyzed. In other words, attending pre-school decreases the probability of having a low grade regardless of the education level of the student's parents.

MODEL AND METHODOLOGY

The econometric model that we will estimate assumes that the score in each of the three subjects *m* (Reading, Maths and Sciences) of a given student *i* who goes to a particular school *j* in the autonomous region *k*, y_{mijk} depends on: a constant μ; p_{ijk}, the number of years that the student attended pre-school; $x_{h,ijk}$ student's individual and socioeconomic variables for *h = 1*, ..., *n*, whose values can vary between students of the same school; of *l = 1*, ...,*o* variables related to the variables of the student's school $z_{l,jk}$, whose values will be the same for students who attend the same school; and a series of fixed effects δ_{ik}, which measure the possible variability at the autonomous region level (included in our estimation basically for the level of GDP per capita of the region and its level of spending on non-university education). So therefore, the equation that we will estimate will have the following expression:

$$y_{mijk} = \mu + \alpha p_{ijk} + \sum_{h=1}^{n} \beta_h x_{h,ijk} + \sum_{l=1}^{o} \gamma_l z_{l,jk} + \delta_{ik} + u_{ij} \quad (1)$$

Our goal is to estimate this equation using linear regression techniques controlled by the population weight of each observation in the sample. In this way in each case we obtain standard errors of each coefficient which are robust to any problems of heteroscedasticity. Table 4.4 shows us the results of the estimations of the impact of attending pre-school for a year, two years and three or more years against not attending at all, on scores in Reading, Maths and Sciences, controlling by the other variables discussed in the previous section. As we can see, attending pre-school for two or more years has a positive impact on Reading scores. However, it seems to have no significant impact on the other two subjects.

It is important to point out that, to the extent that the attendance of pre-school is correlated with other unobservable variables that in turn influence the result of the student (eg: having parents very interested in the socialization and education of the child, which leads them to make the decision to take him or her to pre-school and devote time to improving the learning process at home, etc.), the estimator of the parameter α can be biased and inconsistent. To try to identify the effect of attending pre-school Education on student results we introduce an additional variable in the model which includes the potential population of students by pre-

school center in the region *k* during the years in which the student *i* could attend pre-school depending on their age t_{ik}.[3] So, the model we will finally estimate is:

$$y_{mijk} = \mu + \alpha p_{ijk} + \theta t_{ik} + \sum_{h=1}^{n} \beta_h x_{h,ijk} + \sum_{l=1}^{m} \gamma_l z_{l,jk} + \delta_{ik} + u_{ij} \quad (2)$$

Figure 4.3 offers specific evidence on the relationship between the potential population served by a school and pre-school attendance. Specifically, here we add the potential population and pre-school attendance data by autonomous region. In this way we can see that there is a certain negative relationship between the two: those regions where the number of potential students who should be served by each pre-school center is greater, they show slightly lower rates of pre-school attendance for at least three years. Figure 4.4 shows the relationship between the potential population of each center and the scores in Reading, Maths and Sciences, at the aggregate level by autonomous region. As we can see, there is a negative relationship between them: those regions with a greater number of potential students per pre-school center have worse average scores in the three subjects.[4] This result, yet to be confirmed in the following econometric analysis, could be indicating that in those regions where the availability of pre-school centers per potential student is lower (there is a greater number of potential students per school), student performance in fourth year of Primary school is lower, so it seems that the number of students in pre-school class has a significant return in terms of later student performance.

Finally, our analysis will also study the probability that the grade of each student in the sample is below the first quartile, or above the third quartile, of the distribution. The aim is to analyze whether these probabilities depend differently on how the average grade of the explanatory variables of interest performs. To carry out this exercise we will use discrete choice models, specifically the *logit* model, also controlling by population weight of each observation and obtaining the robust errors to possible problems of heteroscedasticity. The specification of this model is completely standard: we will explain the probability that a binary variable (equal to 1 if the student has a score lower/higher than the first/third quartile of the distribution) takes the value 1 or 0 depending on the same explanatory variables as the previous equation for the individual grade of each student. We will estimate this probability assuming that the error of this equation is distributed following the logistic distribution function.

[3] Appendix III shows the procedure for the calculation of this variable.

[4] The aggregate value of the variable which corresponds to an autonomous region is far superior to the rest (227.08), so we have decided not to consider it in Figures 3 and 4 in order not to distort the results. However, we have considered it in all the results of the subsequent estimations.

RESULTS

In this section we will firstly describe our results for the general model specified for each student's average grade in all three analyzed disciplines, ie: the results of the Ordinary Least squares estimation of the equation (2). Secondly, we present the specific analysis of the effects of variables related to pre-school attendance when we consider such effects as heterogeneous according to the educational level in the home, or the term of birth of the student. Finally, we present the results of the analysis on the probability of having a grade below the first quartile or above the third quartile of the distribution.

Analysis of the average score according to the set of the analyzed explanatory variables

Table 4.5 shows the results of estimating the equation (2) for each of the three subjects. Firstly, regarding the impact of individual characteristics, we see that boys get higher scores than girls in Maths and Sciences while the opposite happens in Reading. Also, we see that boys older than 10 years, ie: boys who may be repeating a year, have significantly lower results than boys who are 10 years old or less, specifically between 47 and 57 points lower depending on the subject. Regarding the impact of the term of birth we see that this variable effectively has a very significant impact: students born in the third or fourth term get between 20 and 32 points less than those born in the first term. Finally, the variable that we consider could measure the student's ability, ie: the one that indicates whether the student does not need parental help with homework, shows a positive and very significant effect on the grade in the three disciplines analyzed.

Secondly, we focus on the impact of the socioeconomic characteristics of the student. Thus, we see that the average income level of the area in which the school is located is a very important variable. In particular we find that students who study in schools located in areas of high or medium income have scores well above those in low-income areas, especially in Language and Sciences. The education level of the parents is a crucial determinant factor of the students' grades, especially the education level of the mother. For example, we see that students whose mothers have university education get on average between 19 and 24 points more, depending on the subject, than those who have mothers with Primary Education. This difference is reduced to between 12 and 14 points if it is the father who has university education compared to a father with Primary Education. Regarding the household possessions that may have an impact on the students academic performance, we see that the number of books at home has a positive and significant effect, as does having internet at home, although the impact of having books is relatively greater.

Thirdly, we analyze the effect of the school characteristics. We can see that being in a public school has no effect significantly different from zero. Regarding the size of the municipality where the center is located, we see that those schools located in medium-sized cities have better scores than those located in large cities, while students who go to schools in small

towns or rural areas get better scores in Maths and Sciences (this variable does not have a significant effect on Reading). We also see that students who go to larger schools (more than 75 students in fourth grade of Primary) get better scores. As for the effect of the characteristics of the teacher, they are not generally very significant. We can exclude the case of the teacher's gender. In particular we see that male teachers have a marginally greater effect than female teachers in the three disciplines. On the other hand we also see that (male?) teachers under 50 years old get worse grades in Maths and Sciences and that those who are specialists in Primary Education have positive effects on the grades in these two disciplines. The teacher's effort, measured by the time spent correcting the students' homework, as explained before, has a marginally significant effect on the Reading grade but a negative effect on the Maths grade.

Finally we focus on the effect of variables related to student attendance to pre-school. The results related to these effects are shown in the last rows of Table 4.5. As we can see, on considering the impact of the number of potential students per pre-school center in the estimation, in general the variables relative to the impact of attendance lose their significance when compared to the results shown in Table 4.4 (which was not controlled by this variable of educational availability). In any case, we continue to see that students who have attended pre-school for three or more years get nearly 16 points more in Reading than those who did not attend pre-school; that is, these students manage to be almost a quarter of a standard deviation above the average student in our sample. This effect, however, is not significant for the other disciplines. It is important to point out that this effect is the net of the possible aggregated effect of a greater availability or supply of pre-school centers. Indeed, we see that the variable that measures the number of potential students per pre-school center, at the ages in which the students of our sample could go to such schools, has a significant negative effect, ie: in the regions where the availability of pre-school centers per potential student was lower (there are more potential students per school), student performance in fourth grade of Primary is somewhat lower. Therefore these results indicate that the number of students in the pre-school class has a significant return in terms of the later performance of the student. Finally we get an interesting negative effect of students who entered Primary Education at less than six years old and above all, of those who accessed that level of education at 7 or 8 years old.

Before turning to the analysis of the results, distinguishing between family or individual characteristics of the student, we wonder if these results could be influenced by the presence of some kind of unobservable heterogenity at the school level and that may even be correlated to some of the explanatory variables included in our analysis. We are thinking, for example, that the pre-school teacher that these students had could have exerted a differential effect on their students depending on their performance as a professional in the classroom. If students who attended the same pre-school class are later grouped in the same Primary school class, this unobservable effect of our database, which is that of the pre-school teacher, could be affecting the estimated effects in our equations that are estimated by linear regression methods that do not take into account the possible presence of this or any other type of unobserved heterogeneity of the class in which the student participates. Therefore, as a test of

the sensitivity to the existence of such heterogeneity, we have also set out the estimation of the equation (2) using panel data techniques. Specifically, and after performing the relevant Hausman tests, we have estimated a fixed effects model for the student's grade in the three considered subjects. The results of these models indicate to us that the effect of pre-school attendance remains positive and significant in the Reading test but not in the other two subjects. The significance of the estimated effect is qualitatively similar to that obtained by linear regression methods (13.45 points in the fixed effects model versus 15.93 in Table 4.5). We also find that the effects of the age of entry into Primary Education are even more similar both in significance and estimated specific effect on the test grade for the three subjects taken into consideration. Therefore, we can conclude that this type of unobservable heterogeneity of the class which the student attends to does not affect the estimated value of the effects of the variables under consideration.

Analysis of heterogeneity in the effects of the variables related to attendance of pre-school Education

As we saw in Table 4.2 attendance to pre-school Education is strongly influenced by certain socioeconomic characteristics of students. In particular the level of education of the parents plays a very important role on this variable. In a context in which public resources are dwindling and where student academic results (which in turn affect their educational performance in subsequent periods as well as their economic earnings) are strongly influenced by their socioeconomic characteristics, as shown in the literature and seen in Table 4.5, it is of the utmost importance to understand what kind of interventions can most benefit the students coming from more disadvantaged socioeconomic environments. Therefore, we analyze next the heterogeneity in the positive impact of pre-school attendance depending on socioeconomic status, particularly according to family education.

To analyze the impact of pre-school attendance according to the family education level we estimate the equation (2) for two groups of students in different ways: those with a father and/or mother with a university education and those who don't have a father nor mother with university education. Columns 2 and 3 of Table 4.6 show us the result of this estimation. Here we can see that the positive effect of attending pre-school for three or more years manifests itself basically among students with parents without university educations, and especially with respect to Reading scores. Moreover, contrary to what we obtained in the previous section (pre-school attendance for three or more years raises the average grade by a quarter of the standard deviation), here we see that the effect is greater for children of non-university educated parents: the grade increases by a third of standard deviation for these children.

Next, we set out to analyze whether pre-school attendance can benefit in a different way those children who were born in different terms of the year. To study the heterogeneity in this sense we estimate the equation (2) again for two groups of students: those born in the first or second term, and those born in the last two terms. Columns 4 and 5 of Table 4.6 show the results. There we can see that the positive effect of attending pre-school for at least three

years takes place mainly among those students born in the third or fourth term of the year, ie: among those most in need of early attention, for which the estimated average score is almost a 36% of standard deviation above the average score observed in Reading. Thus, pre-school attendance can be considered as a type of intervention that would help to reduce the differences in academic performance in later stages of students born between the first and second term of the year.

Analysis of the distribution of the observed grades

As we have said at the end of Section 2, it is interesting not only to focus on the average effects of pre-school attendance but also to analyze the effect on the distribution of scores. In fact, as we shall see below, pre-school attendance also has a different effect throughout the distribution of students' scores in our sample.

To begin this analysis we estimate the impact of pre-school attendance on the probability of having a score below the first quartile and on the probability that the score is above the third quartile of scores of each of the subjects. The results of these two estimations are shown in Table 4.7. Thus, we see that attending pre-school Education for at least three years significantly decreases the probability of having a score below the first quartile of the sample distribution, not only for Language but also for Maths and Sciences. However, attending pre-school does not significantly increase the probability of having a score above the third quartile of the sample distribution of any of the subjects. If we also consider that it is much more likely for a student with a poor socioeconomic environment to be below the first quartile, these results confirm the previous evidence that pre-school attendance primarily benefits students with a low socioeconomic profile.

With the aim of studying this result in more depth, we now analyze the heterogeneity of the impact of pre-school attendance on different points of the distribution according to the student's socioeconomic level. The results are shown in columns 2 and 3 of Table 4.8 (probability of getting a score lower than the first quartile) and in columns 2 and 3 of Table 4.9 (probability of getting a score above the third quartile). In Table 4.8 we see again that the effect of pre-school attendance obtained in the previous regression is primarily derived from the greater effect found among children with non-university educated parents. Finally, and very interestingly, Table 4.9 shows that although in aggregate terms there is no significant effect of pre-school attendance on the probability of getting a good grade in the three subjects analyzed, once we distinguish between students whose parents went to university and students whose parents did not go to university we see a positive and very significant effect of pre-school attendance among the latter.

Finally, we analyze the heterogeneity of the impact of pre-school attendance on different points of the distribution according to the student's term of birth. The results are in columns 4 and 5 of Tables 4.8 and 4.9. There again we see that the negative effect of attending pre-school Education on the probability of having a score below the first quartile is derived primarily from a greater effect found among children born in the second semester of the year.

Furthermore, we see that the positive effect of pre-school attendance on the probability of getting a score in the third quartile is centered mainly on those children born in the third or fourth term of the year.

CONCLUDING REMARKS

Improving the quality of education is a common concern for most of the political authorities at an international level. In this paper we present evidence that shows that investing in pre-school Education (eg: through an increase in the number of places offered) has positive effects on student performance in subsequent levels of education. Specifically, using the PIRLS-TIMSS 2011 database we see that those students who attended pre-school Education for at least three years got about 16 points more (on an average of around 515 points) in Reading tests carried out in this program than those children who did not attend pre-school.

On the other hand we find that the positive impact of pre-school Education mainly manifests itself in terms of a great capacity to reduce the probability of getting very low scores overall, for students who attended pre-school Education for at least three years, and above all for for those who, among these, have non-university educated parents. Similarly, we find that pre-school attendance increases the probability of having very high scores in general and especially among those students born in the last two terms of the year, and also for those whose parents do not have university education. These results imply that pre-school Education is especially helpful for students from families with more disadvantaged socio-demographic characteristics, as well as those most in need of early attention.

There are several extensions to this paper. One of them might be to analyze the effect of going to pre-school on the student's knowledge prior to entry into Primary Education. [14] By doing so we will be able to study whether the effect of pre-school attendance decreases over time, and how it affects the increase of human resources from the moment of the entry into Primary Education until the moment of doing the test in the 4th year of Primary.

To conclude, we can say therefore that promoting attendance of pre-school Education not only has positive effects on later academic performance in aggregate terms, but that it also contributes to promoting the equality of opportunities in that it favours the students with worse profiles to a relatively greater extent (in terms of the family education level or their term of birth).

[14] Fernandez-Blanco et al. (in this volume) conduct a detailed study on the preparation of students prior to their entry into Primary Education and its main determinant factors.

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APPENDIX I: TABLES AND FIGURES

Table 4.1: Descriptive Statistics: Individual and socioeconomic variables

	Average (%)	Stand. Dev.	Scores		
			Language	Maths	Science
Individual Values					
Boy	50.33	0.49	512.33	493.74	514.11
Girl	50.67	0.49	517.29	482.08	504.54
Age (years)	9.51	0.50			
6-8	0.42		473.14	432.27	459.90
9	52.09		514.47	487.59	509.02
10	43.61		520.33	494.25	515.31
11-13	3.88		461.50	426.41	450.78
Birth Term					
1st Term	23.85	0.43	522.67	495.01	517.56
2nd Term	26.08	0.44	520.00	492.43	515.10
3rd Term	24.26	0.42	511.44	484.24	504.39
4th Term	25.79	0.43	505.40	480.38	500.61
Ability Proxy					
Help	85.46	0.35	511.17	483.54	505.14
no help	14.53	0.35	536.11	513.79	534.07
Socioeconomic Variables					
School Income					
HIgh	5.43	0.23	546.89	534.41	545.86
Medium	73.68	0.44	520.61	491.57	514.10
Parents education					
Father with University education	21.13	0.41	546.40	518.87	539.74
Father Baccalaureate-VT	13.26	0.34	516.94	492.62	508.54
Father secondary	27.47	0.45	511.76	485.80	508.02
Father primary	27.80	0.45	500.52	471.99	494.50
Father<Primary	9.71	0.29	493.74	455.80	480.73
Mother with university education	25.72	0.44	543.41	517.68	538.29
Mother Baccalaureate-VT	13.77	0.34	515.23	489.13	504.66
Mother secondary	26.88	0.44	512.01	484,57	507.60
Mother primary	24.88	0.43	499.31	469.30	493.27
Mother<primary	8.25	0.27	481.79	444.40	465.86
Books>100	30.05	0.46	537.72	509.92	534.05
Books<100	69.95	0.46	511.52	479.22	500.51
Internet at home	81.53	0.39	519.26	493.01	514.89
No internet at home	18.47	0.39	495.10	464.97	484.24

Table 4.1: Descriptive statistics: school variables (cont.)

	Average (%)	Stand. Dev.	Scores		
			Language	Maths	Science
School characteristics					
Public	65.11	0.48	508.58	481.55	502.30
Private	34.88	0.48	526.40	498.43	520.91
Urban	41.61	0.49	517.24	490.09	512.29
Rural	13.62	0.34	507.14	491.51	506.46
Big	20.79	0.41	538.71	512.26	531.74
Not big	79.21	0.41	508.52	481.63	503.54
Teacher characteristics					
Gender					
Male	22.08	0.41	519.27	490.93	514.53
Female	77.91	0.41	513.53	487.20	508.05
Age					
20-30	8.90	0.28	501.09	470.22	492.93
30-50	46.67	0.49	511.41	483.58	504.69
Experience (years)	20.68	11.51			
<15	34.53	0.47	505.34	476.69	499.25
15-30	43.28	0.49	519.09	493.96	514.71
30-45	22.18	0.41	521.15	493.41	514.34
Education level					
Low	.17	0.04	545.82	438.86	457.50
Medium	97.77	0.15	514.19	487.37	508.80
High	2.04	0.14	541.11	516.36	536.35
Specific training					
Yes	84.79	0.35	514.87	488.43	510.37
No	15.20	0.35	514.418	485.1287	503.3675

Table 4.2. Pre-school attendance and scores

	Average (%)	Stand. Dev.	Scores		
			Language	Maths	Science
Age of enty into Primary school (age)	5.56	0.55			
5	46.32	0.50	507.53	482.39	502.98
6	51.81	0.50	522.75	494.50	517.00
7	1.87	0.13	474.22	446.11	457.73
Years of attendance of pre-school					
0	3.04	0.17	490.42	473.08	491.79
1	7.78	0.27	496.20	469.96	490.93
2	23.32	0.42	505.79	478.59	501.08
3 or more	65.86	0.47	521.30	494.32	515.55

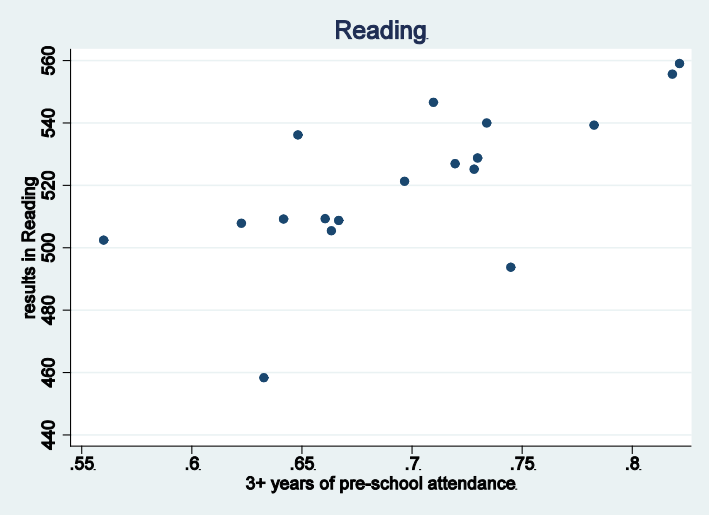
Table 4.3: Pre-school. Individual and Socioeconomic Characteristics

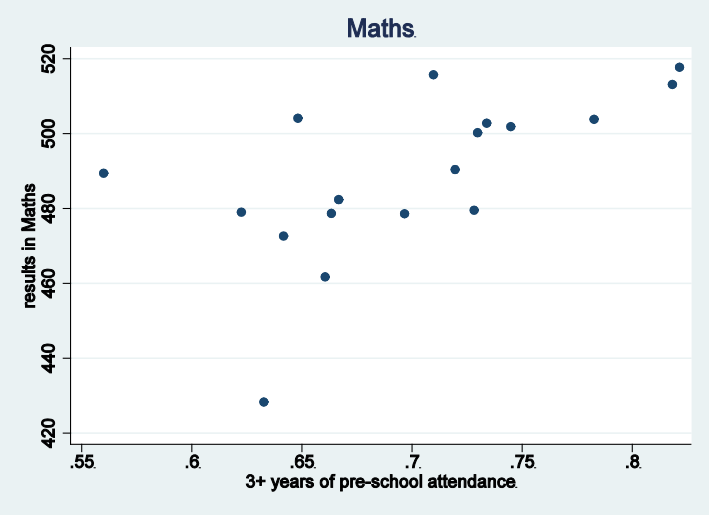
	Years of attendance of pre-school			
Variables	**0**	**1**	**2**	**3 o más**
Gender				
Boy	2.86	8.21	23.11	65.81
Girl	3.22	7.34	23.53	65.91
Birth term				
1st term	3.17	7.41	23.07	66.34
2nd term	3.63	6.85	21.47	68.05
3rd term	2.82	7.16	24.20	65.82
4th term	2.53	9.64	24.58	63.24
Ability Proxy				
Help	3.21	7.97	23.78	65.03
No Help	2.03	6.63	20.57	70.76
Parents education level				
Father				
University	2.28	4.33	16.77	76.61
Baccalaureate-VT	2.50	8.95	23.02	65.52
Secondary	3.94	8.93	23.38	63.75
Primary	2.18	8.43	26.27	63.13
< Primary	5.36	8.76	29.08	56.79
Mother				
University	1.98	4.51	15.85	77.66
Baccalaureate-VT	4.57	8.04	20.85	66.53
Secondary	3.35	8.60	24.20	63.85
Primary	2.33	9.30	28.80	59.57
< Primary	4.84	10.31	31.87	52.97
Household Possesions				
More than 100 books	2.55	6.12	19.02	72.30
Less than 100 books	3.25	8.49	25.16	63.09
Internet at home	2.61	7.87	22.35	67.17
No internet at home	4.93	7.37	27.59	60.10

Table 4.4: Pre-school attendance without controlling by endogeneity

	Reading		Maths		Science	
	Coef.	**Stad. t**	**Coef.**	**Stad. t**	**Coef.**	**Stad. t**
Attend pre-school for a year	5.0637	0.99	-1.3810	-0.22	-3.6982	-0.56
Attend pre-school for two years	11.2080	2.39	2.5101	0.44	2.3668	0.40
Attend pre-school for 3 years or more	14.8357	3.23	7.9431	1.42	6.1686	1.07

Figure 4.1. Pre-school attendance for 3 years or more and Primary school results





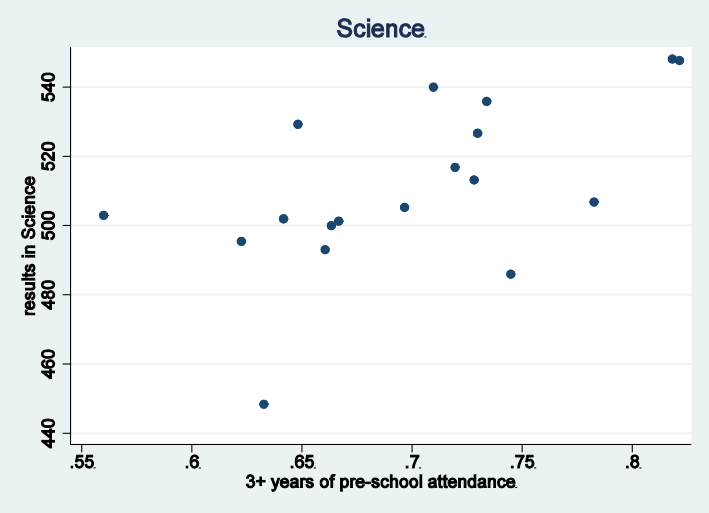
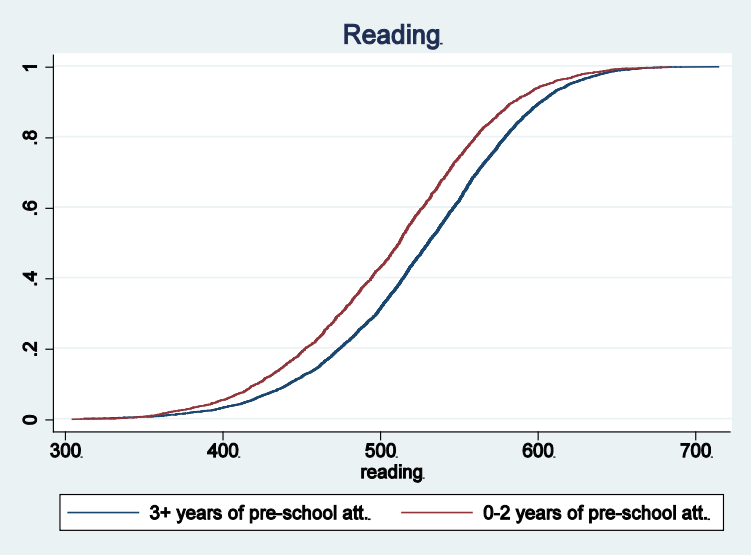
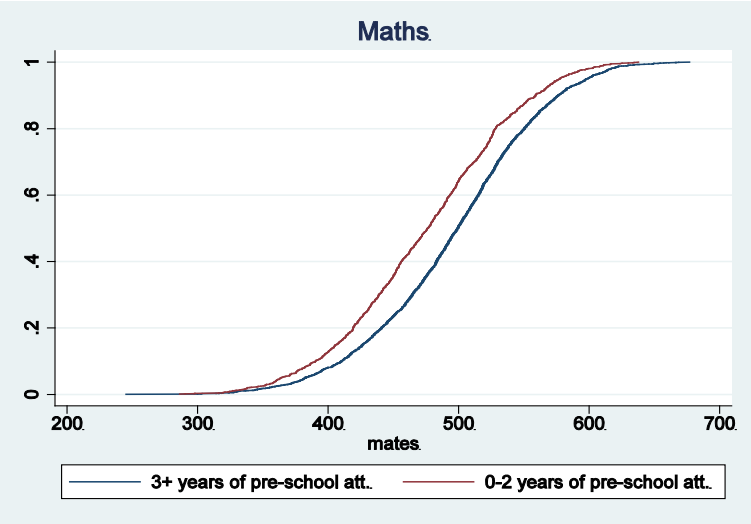
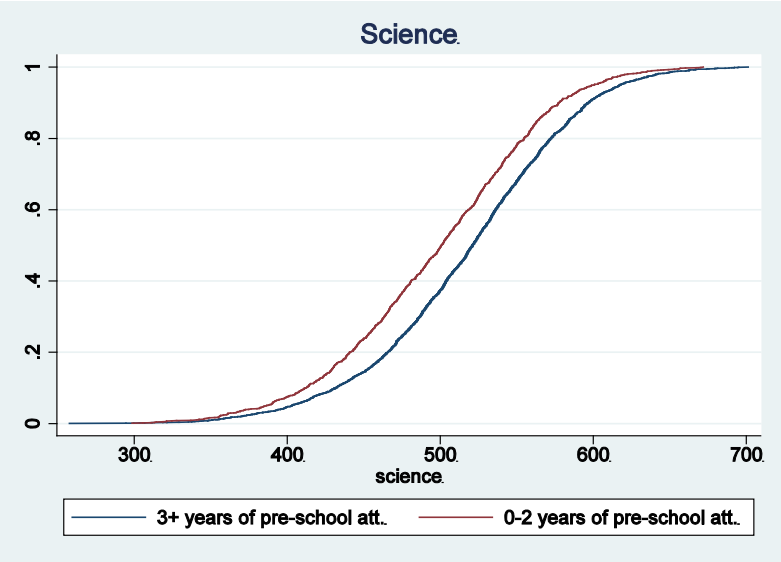


Figure 4.2. Pre-school attendance: Dominance Analysis

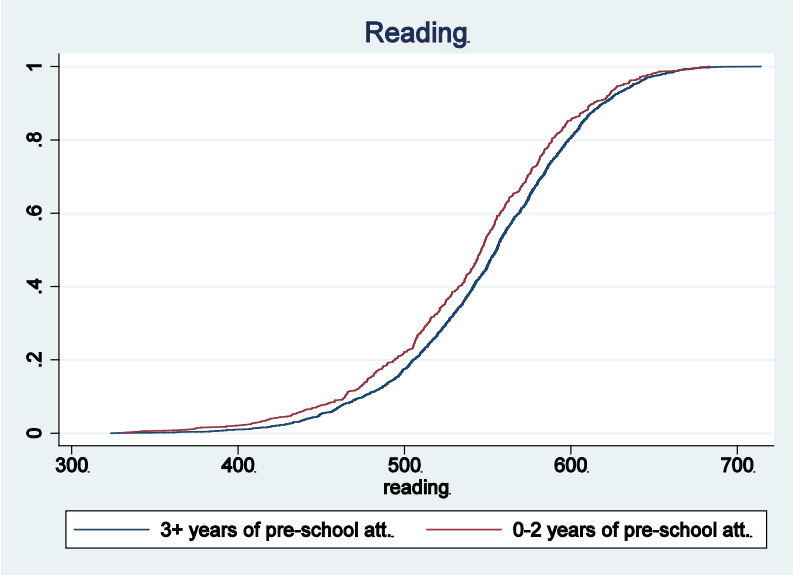
(a) General Population

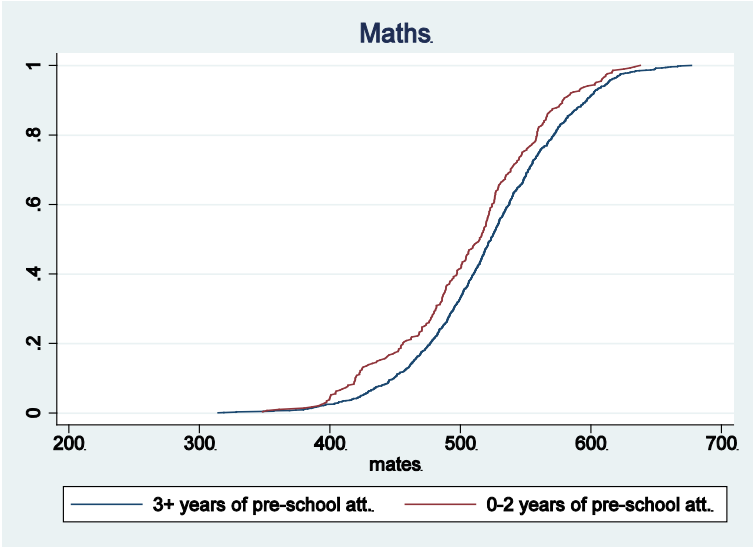


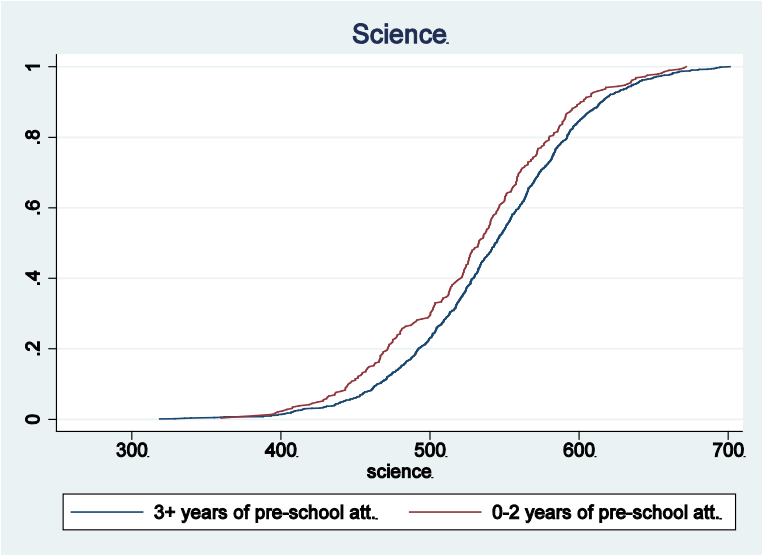




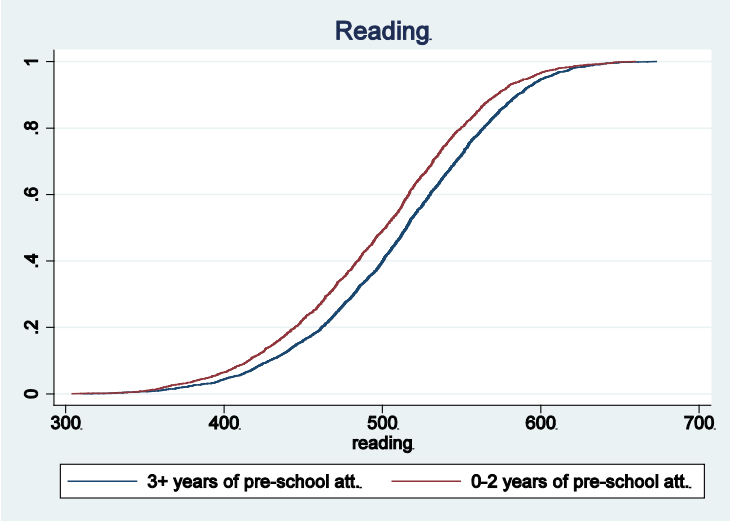
(b) Father or Mother with university education

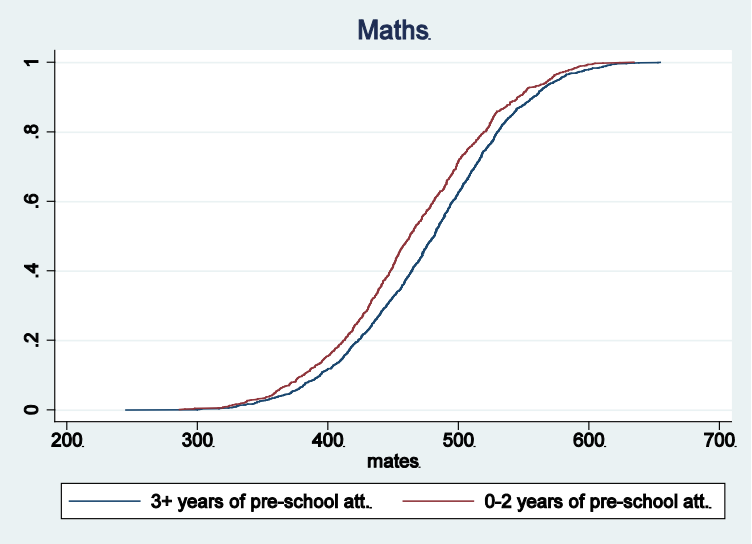






(c) Fathers without university education




Maths
0
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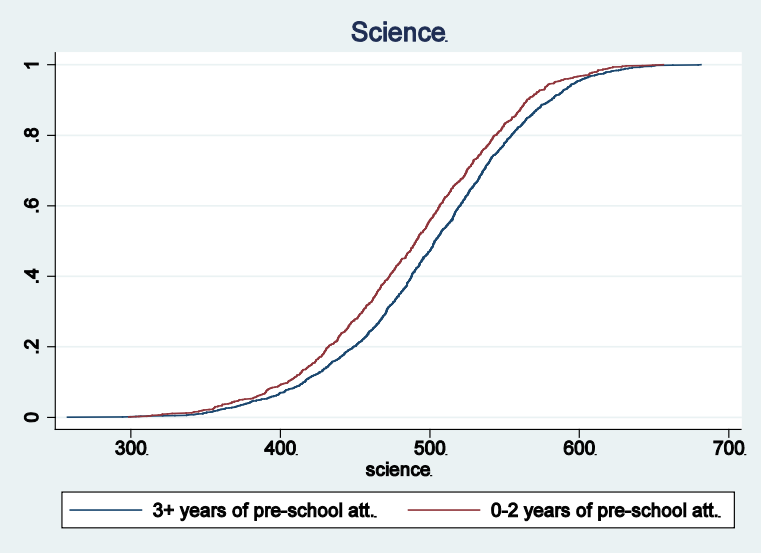
700
mates
3+ years of pre-school att..
0-2 years of pre-school att..


Science
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science
3+ years of pre-school att..
0-2 years of pre-school att..

Figure 4.3: Attendance Rates and Potential Population

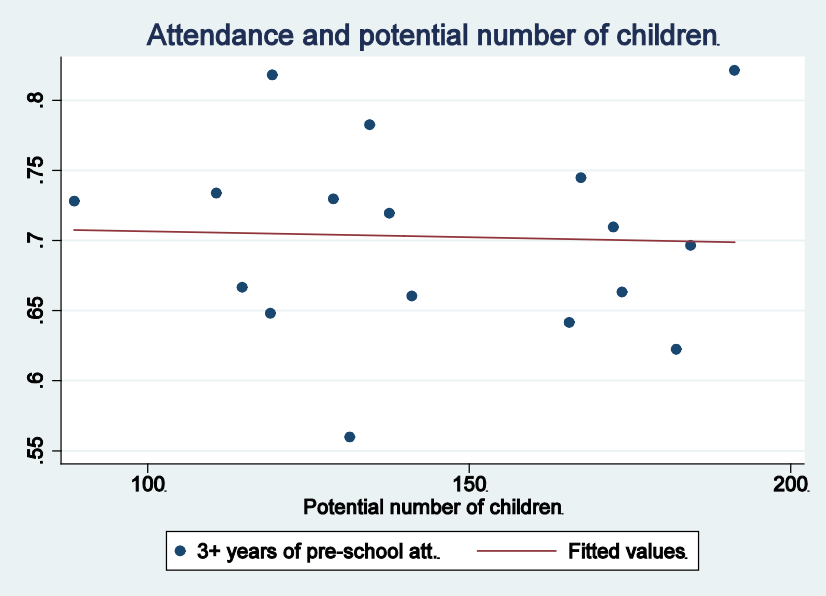
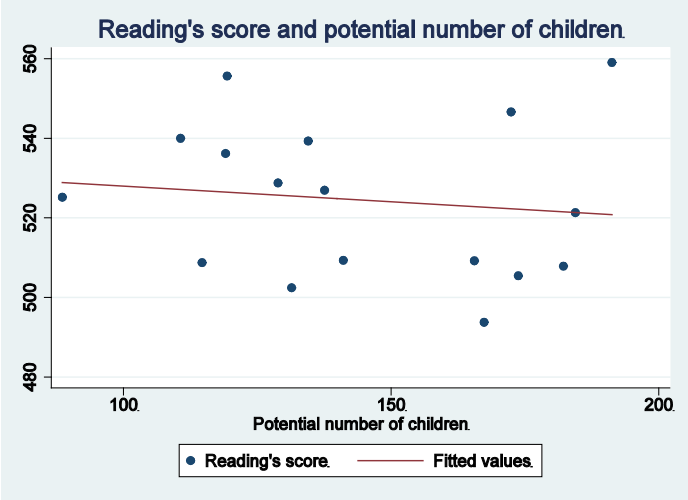
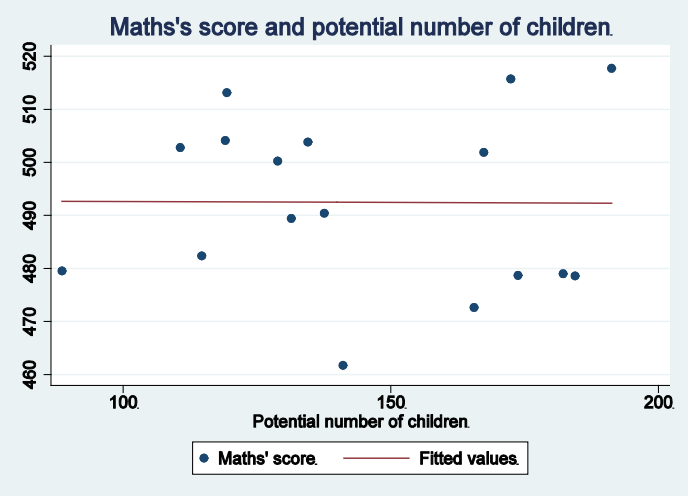


Figure 4.4: Results and Potential Population





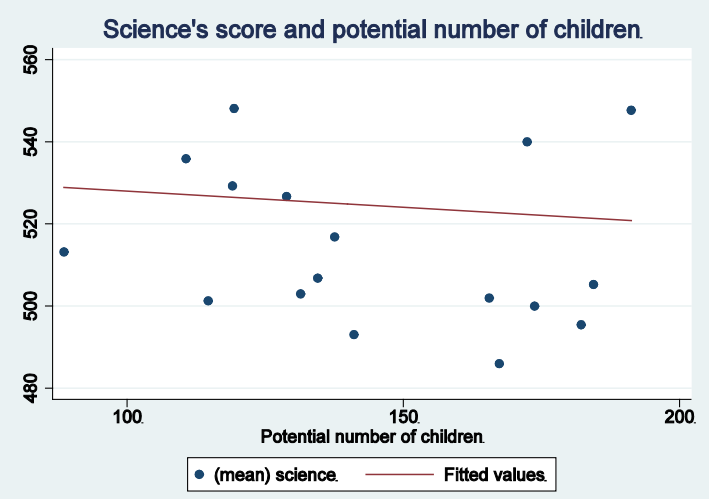


Table 4.5: Results of linear regression model for the three subjects

	Reading		Maths		Science	
	Coef.	**Stad. t**	**Coef.**	**Stad. t**	**Coef.**	**Stad. t**
Individual variables						
Child gender=male	-5,2630	-2,81	10,9126	4,88	9,0988	3,92
Age>10 years old	-47,2454	-8,05	-56,9376	-9,05	-54,0113	-7,93
Birth term = 2nd	-5,5476	-2,14	-4,5600	-1,44	-4,7483	-1,46
Birth term = 3rd	-14,9258	-5,54	-13,0585	-3,91	-15,3899	-4,56
Birth term = 4th	-20,4715	-7,01	-17,8858	-5,34	-20,0753	-5,59
Student's ability proxy	18,9860	6,75	22,7709	7,30	22,0421	6,32
Socioeconomic variables						
School in medium or high income area	23,3561	8,98	15,1899	4,35	22,9127	6,56
Father, university education	16,3917	4,73	14,5827	3,61	12,2099	2,95
Father, Baccalaureate-VT	6,8451	1,98	9,5302	2,25	5,8277	1,35
Father, secondary education	2,5988	0,95	5,4715	1,60	4,8843	1,40
Father, education lower than primary	1,5234	0,44	-3,1789	-0,66	-0,7428	-0,14
Mother, university education	19,8993	5,75	24,1414	6,03	22,8341	5,39
Mother, Baccalaureate-VT	6,2537	1,82	6,3488	1,46	1,9315	0,43
Mother, secondary education	5,5403	2,00	7,7596	2,19	7,0815	1,92
Mother, education lower than primary	-13,6610	-3,66	-17,5301	-3,40	-21,7180	-4,04
Internet at home	10,4424	3,93	11,2129	3,44	14,4536	4,29
Books at home > 100	14,1410	6,88	12,7527	5,15	18,3040	7,01
School variables						
Public school	2,2727	1,02	0,8777	0,33	-0,6747	-0,25
School in large city	-8,7047	-4,30	-9,0394	-3,64	-9,0921	-3,62
School in a town	2,5390	0,74	21,9924	4,85	10,7310	2,29
Large school	11,1202	5,16	10,4049	3,87	4,5138	1,61
Teacher, Male	5,2924	2,59	6,7955	2,62	7,3454	2,80
Teacher, 20-30 years old	-6,8065	-1,29	-23,5880	-3,87	-24,1758	-3,57
Teacher, 30-50 years old	-1,9789	-0,73	-10,1099	-3,16	-9,2494	-2,75
Teacher's years of experience	0,0874	0,68	-0,0817	-0,55	-0,2591	-1,65
Teacher, Graduate or more	5,3649	1,24	7,7515	1,50	7,8814	1,34
Teacher, primary education major	2,1117	0,81	7,5815	2,28	11,8879	3,51
Teacher's effort	5,1985	1,67	-15,2301	-2,62	-0,7045	-0,14
Went to pre-school for a year	6,1324	0,79	-2,0980	-0,25	-1,8909	-0,22
Went to pre-school for two years	11,5111	1,58	1,7138	0,22	3,8272	0,48
Went to pre-school for three years or more	15,9327	2,24	6,0309	0,80	6,8173	0,88
Nº of potencial students per pre-school center	-0,1847	-4,21	-0,1200	-2,74	-0,2541	-5,73
Age of entry into primary school = 5 years old	-5,0757	-2,43	-2,5916	-1,05	-4,5591	-1,78
Age of entry into primary school = 7-8 years old	-26,7016	-3,32	-26,7081	-2,63	-35,5309	-3,54
Constant	573,5849	27,64	484,4243	22,08	599,9053	29,71

NOTE: In these regressions the regional fixed effect is controlled by two aggregate variables on a regional level (GDP per capita and non-university education spending). In the constant term of these regressions the following effect is seen: a student who studies at a private school, in a low-income area, in a medium-sized city, whose teacher is a women over 50 years old with a teaching degree, who did not attend pre-school, whose age of entry into Primary school was over 6 years old, with parents who have a Primary Education, without internet at home, with less than 100 books at home, female, aged 10 years or less and born in the first term of the year. The R2 of each regression is 0.227 (Reading), 0.275 (Maths) and 0.276 (Sciences).

Table 4.6: Results of the analysis of heterogeneity in the effects of the pre-school variables

	According to the education level of the parents		According to the term of birth of the child	
	One with university education	**Neither with university education**	**First or second**	**Third of fourth**
READING				
Went to pre-school for a year	-8,8507	10,8114	-13,9742	21,2649
	(-0,55)	(1,28)	(-1,23)	(2,21)
Went to pre-school for two years	-4,5318	16,6333	7,7720	12,1839
	(-0,30)	(2,11)	(0,73)	(1,38)
Went to pre-school for 3 years of more	0,9091	20,9864	9,8810	22,4448
	(0,06)	(2,72)	(0,95)	(2,62)
MATHS				
Went to pre-school for a year	-0,1325	-3,0518	-21,4475	10,6162
	(-0,01)	(-0,33)	(-1,76)	(0,93)
Went to pre-school for two years	-4,1867	1,6699	-2,0832	-0,0076
	(-0,28)	(0,19)	(-0,18)	(0,00)
Went to pre-school for 3 years of more	5,2434	4,5045	3,9962	7,2212
	(0,36)	(0,53)	(0,36)	(0,71)
SCIENCES				
Went to pre-school for a year	-1,5496	-2,8942	-24,5319	15,4505
	(-0,08)	(-0,30)	(-1,98)	(1,33)
Went to pre-school for two years	0,1227	3,8366	0,8071	4,2911
	(0,01)	(0,44)	(0,07)	(0,41)
Went to pre-school for 3 years of more	8,4636	4,5387	3,2451	12,0457
	(0,50)	(0,53)	(0,29)	(1,18)

NOTE: We show the t statistic in brackets. These regressions are controlled by the same set of variables as in Table 4.5 except those related to the effect to be measured in each column (parental education or birth term, respectively). The R2 coefficients of these regressions are between 13.91% and 26.05%.

Table 4.7: Results of the LOGIT analysis of the probability of having a lower score than the first quartile or above the third quartile for each of the three subjects

	Probability of being in:	
	Percentile 25	**Percentile 75**
READING		
Went to pre-school for a year	-0,1733	0,0149
	(-0,63)	(0,04)
Went to pre-school for two years	-0,4600	0,094
	(-1,82)	(0,27)
Went to pre-school for three years or more	-0,5248	0,3689
	(-2,13)	(1,11)
MATHS		
Went to pre-school for a year	-0,1957	-0,0868
	(-0,67)	(-0,30)
Went to pre-school for two years	-0,3906	0,0811
	(-1,45)	(0,30)
Went to pre-school for three years or more	-0,4873	0,2234
	(-1,88)	(0,84)
SCIENCES		
Went to pre-school for a year	-0,2972	0,2060
	(-1,02)	(0,72)
Went to pre-school for two years	-0,5550	0,2272
	(-2,07)	(0,87)
Went to pre-school for three years or more	-0,6251	0,3148
	(-2,41)	(1,24)

NOTE: We show the t statistic in brackets. These regressions are controlled by the same set of variables as in Table 4.6. The PSEUDO R2 of these LOGIT models are between 12.54% and 22.84%.

Table 4.8: Results of LOGIT analysis of the probability of having a lower score than the first quartile: results according to the educational level and the term of birth

	According to the education level of the parents		According to the term of birth of the child	
	One with university education	**Neither with university education**	**One with university education**	**Neither with university education**
READING				
Went to pre-school for a year	0,1151	-0,2297	0,4675	-0,6392
	(0,18)	(-0,76)	(1,21)	(-1,68)
Went to pre-school for two years	-0,4054	-0,4999	-0,4745	-0,3743
	(-0,67)	(-1,82)	(-1,32)	(-1,09)
Went to pre-school for 3 years of more	-0,5098	-0,5812	-0,4510	-0,6357
	(-0,90)	(-2,16)	(-1,21)	(-1,90)
MATHS				
Went to pre-school for a year	0,5079	-0,2426	0,1750	-0,3059
	(0,69)	(-0,76)	(0,43)	(-0,70)
Went to pre-school for two years	0,5280	-0,4659	-0,4280	-0,0928
	(-0,82)	(-1,58)	(-1,14)	(-0,23)
Went to pre-school for 3 years of more	-0,0194	-0,4950	-0,5843	-0,2684
	(-0,03)	(-1,72)	(-1,61)	(-0,69)
SCIENCES				
Went to pre-school for a year	0,3870	-0,3351	0,1831	-0,5324
	(0,47)	(-1,03)	(0,44)	(-1,28)
Went to pre-school for two years	0,1541	-0,6277	-0,6224	-0,3177
	(0,21)	(-2,10)	(-1,61)	(-0,84)
Went to pre-school for 3 years of more	-0,3318	-0,6283	-0,6548	-0,5038
	(-0,47)	(-2,25)	(-1,74)	(-1,38)

NOTE: We show the t statistic in brackets. These regressions are controlled by the same set of variables as in Table 4.6. The PSEUDO R2 of these LOGIT models are between 12.54% and 22.84%.

Table 4.9: Results of the LOGIT analysis of the probability of having a lower score than the fourth quartile: results according to the educational level and the term of birth

	According to the education level of the parents		According to the term of birth of the child	
	One with university education	**Neither with university education**	**One with university education**	**Neither with university education**
READING				
Went to pre-school for a year	-0,4080	0,2059	-0,9926	1,3855
	(-0,07)	(0,40)	(-2,18)	(1,91)
Went to pre-school for two years	-0,4002	0,3804	-0,4713	1,1640
	(-0,73)	(0,78)	(-1,12)	(1,66)
Went to pre-school for 3 years of more	-0,2546	0,7434	-0,1371	1,5141
	(-0,48)	(1,57)	(-0,34)	(2,18)
MATHS				
Went to pre-school for a year	-0,0708	-0,1689	-0,7145	0,5721
	(-0,12)	(-0,48)	(-1,87)	(1,28)
Went to pre-school for two years	-0,0688	0,0238	-0,2680	0,4879
	(-0,13)	(0,07)	(-0,75)	(1,15)
Went to pre-school for 3 years of more	0,2518	0,1191	-0,0981	0,7094
	(0,49)	(0,36)	(-0,28)	(1,75)
SCIENCES				
Went to pre-school for a year	-0,2897	0,3576	-0,5023	1,1126
	(0,52)	(1,09)	(-1,31)	(2,55)
Went to pre-school for two years	-0,1939	0,3720	-0,1508	0,9115
	(-0,37)	(1,23)	(-0,44)	(2,24)
Went to pre-school for 3 years of more	0,1384	0,3782	-0,0316	1,0647
	(0,27)	(1,28)	(-0,09)	(2,67)

NOTE: We show the t statistic in brackets. These regressions are controlled by the same set of variables as in Table 4.6. The PSEUDO R2 of these LOGIT models are between 12.54% and 22.84%.

APPENDIX II

As indicated in the text, we proceeded to impute missing values for a series of explanatory variables used in our model through multiple imputation techniques described in Rubin (1987) and Schafer (1997). These techniques are based on predicting these unobserved values, using the observed values on each of the variables on which the imputation is done, and using a regression model (or discrete choice if the imputed variable takes discrete values), in which observed variables are used for the entire sample and that are related, as far as possible, to the sample design (sample weights, identifiers of population groups, etc.) as well as individual and aggregate variables that show strong sample correlation with the variables which are going to be imputed. Specifically, in our case, we have included a series of family and individual characteristics observed for all individuals in the sample as well as variables measuring the sample weight of the class and of each student's home within the sample, as well as the set of variables aggregated at a regional level that we have included in the other models presented.

The set of variables on which some unobserved value has been imputed as well as the number of imputations carried out is provided in the following table.

Table 4.10. Imputations on explanatory variables

Variable	Number of imputations	
Goes to pre-school	579	7,26%
Years of pre-school	795	9,97%
Age of entry into primary school	732	9,18%
Student does not need help in Maths	632	7,92%
Home with internet	27	0,34%
Teacher’s gender	186	2,33%
Teacher’s age	227	2,85%
Teacher’s experience (years)	476	5,97%
Teacher’s level of training	334	4,19%
Teacher specialized in primary education	316	3,96%
Teachers effort in Reading	635	16,75%
Teachers effort in Maths	319	8,41%
Teachers effort in Sciences	464	12,24%

APPENDIX III

The aggregated variables at an autonomous region level that we use in our model are, firstly, the GDP per capita of the region for 2010, per capita education spending in non-university education for the period 2000-2010 and the potential number of students between 0 and 5 years per school that offers pre-school Education in each region, for the years in which the students in our sample were able to attend pre-school Education. Specifically, this variable has been constructed using the following procedure:

1º. We identify the academic years in which the student was able to attend the 2nd pre-school cycle:

Table 4.11: Year of birth and 2nd pre-school cycle

Year of Birth	Start 2nd cycle (2-3 years)	End of 2nd cycle (5-6 years)	Period 2nd Cycle
1998	2001/02	2003/04	2001/04
1999	2002/03	2004/05	2002/05
2000	2003/04	2005/06	2003/06
2001	2004/05	2006/07	2004/07
2002	2005/06	2007/08	2005/08
2003	2006/07	2008/09	2006/09
2004	2007/08	2009/10	2007/10

2º. We take the number of centers which offered pre-school of the first and second cycle in the autonomous region during those years (source: Ministry of Education).

3º. We take the number of children between 0 and 5 years old in each of these school years (source: National Statistics Institute, Annual Census).

4º. We divide the number of students of pre-school age between the number of schools available, for each year. In this way we get the "potential population served by a school" for each year.

5º. To each student we impute the average of that "potential population" for the years in which he/she attended pre-school Education.

Chapter 5

Performance in Reading and Gender: a Small Difference Motivated by Social Factors

PERFORMANCE IN READING AND GENDER: A SMALL DIFFERENCE MOTIVATED BY SOCIAL FACTORS

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SUMMARY

This study addresses the question of gender differences in reading. The aim is to contribute to the debate on whether they are due to socialization or innate, and furthermore, whether the differences in reading in childhood may be one of the elements that contribute to the explanation of the gender gap in school failure in adolescence, much higher among boys than girls (with rates of 31.2% and 20.3%, respectively, during the 2009/2010 academic year). In order to do this we have considered six types of variables: an indicator of cognitive maturity (month of birth), the socio-cultural level of the families, family educational practices prior to schooling, the teaching methods for reading of the teachers, the interest and facility in reading as perceived by the children themselves. Firstly, we set out the background to the debate on the differences in educational performance by gender, followed by the relevance of using multi-level models in educational research. Subsequently, we will present a description of the variables considered and proceed to multivariable estimates, in order to determine the net effects of the different variables considered and to find out the weighting of the differences between schools in reading. Finally, in light of the results, we will propose a series of recommendations aimed at improving the reading performance of boys and girls.

BACKGROUND

The PIRLS Program, which assesses 4th year students, highlighted in its Reports for 2001 and 2006 (Mullis et al., 2003 and 2007) that girls get a better performance in reading than boys and that this advantage corresponded, on mean for all participating countries, to 20 points in 2001 and 17 in 2006. Other international studies agree in documenting differences in the performance of students in different disciplines depending on their sex. For example, the PISA Program, which measures the skills of 15 year old students, shows that there is a clear advantage in favor of girls in reading, and a certain superiority of boys in mathematics, the gender differences being much less evident in the area of the sciences (OECD 2010c).

Inequalities in performance depending on the sex of the students have been of interest to the scientific community for several decades, and a substantial body of research has been developed. It has been addressed by such different disciplines as Biology, Psychology, Economics and Sociology. The explanations can be summarized in the broader debate on "nature or nurture?"

From the first perspective, the performance differences in different areas originate in the innate characteristics of men and women, pointing to various factors such as the composition of their brains and the skills that happen to be most common in each sex. Some differences in the cognitive area at a biological level are well established. The meta-analysis of Spelke (2005), shows superiority of women in verbal fluency, arithmetic and spatial memory for location of objects; the men, in turn, would surpass women in verbal analogy, mathematical problems, memory for geometric configuration and the environment. The author stresses that these differences do not mean an advantage for men in the areas of maths and science. In fact, the differences that are observed in the field of cognitive skills are small when compared to the magnitude of the differences found in other areas (motor behavior, sexuality and aggression, for example).

From the nurture perspective it is proposed that the influence of the environment is what explains the differences in performance between men and women. There are many elements which the literature has pointed out as possible sources of difference in the performance of boys and girls.

The PISA reports, for example, have tended to relate these differences with upbringing and social environment: the preferred options of both sexes for certain career paths, the social and cultural context (which may, for example, encourage educational achievement of one sex more than the other), educational policies and practices or the attitudes of boys and girls with respect to different areas (the girls would show greater commitment towards reading than boys, but greater anxiety towards maths) (OECD , 2002, 2004.2008, 2010).

Some research focuses on studying the influence of gender role models, while others investigate how these may affect the self-concept that boys and girls have about their abilities. In this line of research we will find two recent studies for the case of Spain. González de San Román and de la Rica (2012) show that the fact of having a mother who works outside the home is associated with better performance in the PISA maths test in the case of girls; this effect is particularly significant in Spain and occurs with greater intensity among daughters of mothers with higher educational levels. The explanation that the authors give for this result is that the girls with mothers who work outside the home are influenced by a female model which contrasts with the traditional one, and therefore have greater opportunities to question it. In this way, they are more able to see themselves as just as competent as the males in the area of mathematics, something which would positively influence their results. Other authors propose a different interpretation pointing to a self-selection effect, since the characteristics of mothers who choose to work outside the home are different from those who choose not to, and so there would not be as much exposure to the role of the mother, but rather to parenting practices or other characteristics which distinguish some mothers from others (Golgberg,

Prause and Lucas-Thompson 2008); in as much as the activity rates of married women with low levels of studies is much lower than that of other women, this profile may be expected, and indeed, to be associated with other features relevant to the educational performance of their children.

Meanwhile Sainz and Eccles (2012) document, among other findings, that boys have a better self-concept than girls in the area of maths though the girls show better school performance in this area on finishing Compulsory Secondary Education (CSE). If self-concept is directly related to performance, we would expect that of girls to be higher, or at least equal, to that of the boys. The fact that it does not happen in this way is explained by the authors from the statements that men and women make about their mathematics performance: both boys and their parents tend to attribute good performance in maths more to talent, while the girls and their parents associate it with effort. This has an influence in that while boys boast about (and overestimate) their skills, girls maintain a more modest attitude (tending, rather, to underestimate their skills in the area of mathematics).

Other lines of research seeking explanations for performance differences between men and women have pointed to factors as diverse as the differential use of cultural resources (Dumais, 2002), the degree of differential involvement of parents in different activities with their children depending on their sex, the influence their expectations may have on their performance, the greater anxiety that most women feel when doing maths tests or the behavior and characteristics of the teachers (Buchmann et al 2007). Alongside that it has also been attempted to determine at what point we begin to see differences in student performance on the basis of sex, whether the differences increase over time, whether at some point they become stabilized and whether they affect students of certain characteristics to a greater extent (eg: those with the best or worst performance) (Robinson and Lubienski, 2011).

In the literature explanations can also be found of the differences in achievement between men and women, and they are more related to aspects which are not strictly about education and socialization, such as the labor market. Until some decades ago men managed to make more progress in the educational system than women, a situation that has been changing considerably since the 1970s. The highlighted issues are related to family resources (economic and cultural resources), the environment provided by the family, the neighborhood and the school, the individual expectations or the costs of opportunity of studying (Buchmann et al 2007). In the case of Spain, Martínez García (2010) shows that women have a lower administrative school failure (defined as failure to achieve a Certificate of Secondary Education qualification in the academic year in which they turn 16) than men of their same social class. This difference is explained by the differential weight which has side effects for both sexes, ie: that the costs and benefits of studying are different for boys and for girls. From this perspective, for girls studying is more worthwhile than for boys for three reasons. Firstly, the unemployment rate for men if they haven't completed their studies is lower, so that the cost of the opportunity of studying is lower in the case of women. Secondly, given that domestic work is carried out mainly by women in the home, it is reasonable to think that a girl who does not study will come under greater pressure to take on more work of this type. Finally, the "marriage market" continues to be an important source of social mobility for women; in that

sense, reaching a higher level of education increases the chances of finding a partner with a better social status.

The international measurements, such as PIRLS or PISA, represent an excellent opportunity to test the two streams of thought briefly outlined. In very simple terms, if the performance differences between men and women can be explained by biological factors they should be constant over time and similar across different countries. If, on the other hand, they are due to the influence of the environment and socialization, countries should show clear trends and differentials depending on their socio-cultural characteristics.

According to Carabaña (2008) the findings of the PISA data do not allow us to either corroborate or refute either hypothesis. It is observed that, in general, women do better in reading and men in maths, the differences not being significant in science. One might think that this finding supports the "biologist" school of thought though, however, the differences between countries are too broad. This pattern (inequalities do exist, but vary by country) may support the theory that there are small biological differences that are amplified or reduced by sociocultural contexts (Wood and Eagly 2002).

Moreover, some studies using the PISA database agree that in countries where there is greater gender equality women obtain better performance in maths and outperform boys in reading even more (González de San Román and Rica 2012; Guiso et al. 2008). However, according to Carabaña (2008) it is practically impossible to identify common sociocultural elements between countries with similar performance patterns between boys and girls. For example, he shows that, among the countries which show the smallest differences in mathematics performance, there are some as different from each other as Sweden, South Korea and Turkey.

The influence of schools on educational performance

The influence that schools can have on their students' performance has been associated with numerous diverse factors: the infrastructure and educational materials available to students, organizational aspects such as teamwork and the leadership of the principal, an atmosphere of more or less discipline and commitment in which the process of teaching-learning is carried out, the professional skills of the teachers and their teaching styles, and the sociocultural environment the school provides, among others.

The literature on which elements of a center have most impact on its students' performance began to grow profusely in response to the findings of the Coleman Report (1966), which held that schools had a very modest impact on the educational results of the students and that they were significantly influenced by the characteristics of their families of origin. Since then many studies have been carried out, though the fact is that the empirical evidence does not provide definitive conclusions on several of the issues raised. In fact, the debates are still open and ongoing, although the evidence of the importance of socioeconomic status of the family and of the center tends to dominate over the characteristics of the schools (Gamoran and Long 2006). Nowadays it is normal for studies which examine the influence of school factors on performance to incorporate within their controls some kind of variable which informs us about

the socioeconomic level of the student body, something which answers the need to consider that the school acts in a particular context and that its influence should not be underestimated.

In this regard, recent research documents a characteristic and very significant effect of the measurements of socioeconomic and cultural composition of schools on student performance, and the same would apply for the academic composition of the schools (Cervini, 2006). The PISA Reports indicate that the weight of the socio-economic variables at the aggregate level is very relevant in all participating countries, explaining in Spain 7.2% of the variance in reading performance within each school and 48.4% of the variance between centers, and which, in fact, turns out to be higher than those which have the same variables measured at the individual level, 14% (OCDE 2010a). It should also be noted that, although social background is the characteristic measured by PISA that has most influence on reading, there is a lot of variance that still has to be explained.

That said, the significance and magnitude of the effect of composition and its relationship to learning continue to be the subject of research (Cervini, 2006). Specifically, some studies that include the social composition of schools as a control variable take this as a measure equivalent to the effect of peers, and there is a debate about the accuracy of this interpretation. A recent study, carried out with PISA data from Chile, shows the existence of a significant effect of the socioeconomic composition of schools on student performance. This could be interpreted as evidence that student results are strongly determined by the school they attend and, more specifically, by the socioeconomic characteristics of their students. However, when analyzing the grades that students get through the different academic years, the relationship between these and the socioeconomic level of the schools they had attended was completely blurred (Ugalde, Córdoba and Carabaña, 2012). This leads to the following hypothesis: we are not looking at a peer effect, but one of self-selection. This means that students are grouped in schools depending on certain unobserved characteristics (of themselves or their families), its effect being erroneously attributed to the mean socioeconomic level of the centers. The fact of whether the socio-economic weight of the school composition is due to peers or self-selection leads to different implications. If the effect is due to the the peers, it means that a child's performance will be influenced by the socioeconomic level of their classmates. But if it's a self-selection effect of the families, the social background of their peers will not influence the results.

In terms of methodology, the study of the influence of schools on educational results has been greatly enriched by multilevel analysis techniques. These recognize the complexity of the data usually found in education to the extent that they are found grouped or hierarchized at different levels: students are grouped into courses and these in turn belong to certain schools, which may be located within more global contexts (districts, cities, etc.). The individuals of these groups share a series of common influences so that the responses of students from the same center can be expected to resemble each other more closely, either because of the characteristics of their families, their schools or their common history (Gaviria and Castro 2005). That is, students who belong to the same school are most probably not independent of each other and this is a serious breach of the independence of the observations, which is one

of the assumptions of general linear regression (Pardo, Ruiz and San Martín 2007). Multilevel models allow us to address precisely this difficulty by allowing us to work with variables in parallel both individually and in groups, with attention to the covariance between the data[1].

In this paper we have opted for the use of this technique because of the advantages mentioned above. We will work with a series of variables that characterize the students individually and another two that provide information about schools: the pedagogical practices used by its teachers and its socioeconomic status (measured by the percentage of university-educated parents).

EMPIRICAL ANALYSIS

The PIRLS data provide a wealth of information on the family characteristics, their educational practices with their children, the aptitudes and interests of the latter, as well as the characteristics of the teachers and the education center. In order to focus our study, we have limited the analysis to a few which, while they are not exhaustive, allow us to take into account the main factors influencing reading performance. In this section we present these variables as well as the results for girls and boys.

Firstly, two variables, which are unrelated to others used, were considered as a control: the sex and the month of birth. Then, in order to gauge the influence of the social background of the student's family, we have worked with the following indicators. First, the educational level of the father and mother, who we've dealt with separately, in case there is any difference in its influence depending on the sex of the parents or guardians of the children. Along with this we have considered the family's social class as defined by the occupation of higher status of either parent. Also, in order to find out whether the person with a higher level of education or the best occupation is the man or woman, we created two variables of homogamy, ie: pairing between people of similar social characteristics. In case of discrepancies, if it is in favor of the man, it is said that the situation is hypergamy, but if it is in favor of the woman, hypogamy[2]. Furthermore, we differentiate between mothers without work experience and the rest. Finally, we have created a series of variables designed to explore the possible interaction between the sex of the student and the socioeconomic characteristics of the family.

[1] (Hanushek 2004; (Angrist and Lagn 2002)), while others go further and question the peer effect itself (Vygdor and Nechyba 2004; Cullen, Jacob and Levitt 2003, 2006).

[2] These comments may sound sexist, but are a reflection of a situation in which men, with equal levels of education or occupation, earn more income than women, and therefore in those families where it is the woman who has a better social position it is more likely that they have fewer resources than if it is a man.

We have also developed an index of the early educational practices of the family, which summarizes the information from a series of questions about how they have encouraged reading in their children prior to their admission to primary education.

On the individual characteristics of the respondents, we have developed the following indices: interest in reading, aptitude and facility with which they read. The development of these indices has been somewhat crude, and deviates from the rigor with which the team of Tourón et al. (2012) have developed their own but, despite this, the parameters estimated with these indices are significant and show the expected result, so we believe that the use of a more sophisticated methodology may balance the data better, but would not change their interpretation substantially.

Finally, we have considered two variables of the center. The first points to the teaching methods used by teachers; we have chosen to create an index incorporating those variables which in the bivariate analysis were associated more strongly with reading performance. The second takes into account the mean socioeconomic level of the schools, measured by the percentage of university-educated parents.

In the case of the early educational practices of families, as well as the interest and facility regarding reading, we observed an association between these factors and social background and month of birth, which is why in the multivariable analyses we have not taken these indices directly, but the residues of the variance analysis of each of these indices with respect to social background. The results of these variance analyses are presented in the appendix.

Reading performance of girls and boys

In the case of Spain, the distribution of reading performance shows little difference between the sexes: the girls get a mean of 515.53, while the boys get 510.65 (Table 5.1). This small difference is statistically significant, because bearing in mind the standard error, the margin of random error is within a range of about four points (± 2 points, with 95.5% confidence). The difference is significant, but is it educationally relevant? To calibrate its magnitude we must take into account the standard deviation, that is 65 for the overall distribution. Therefore, the distance between the two sexes is just under a tenth of standard deviation, a size considered small (Cohen 1988), although it is recommended that educational research take into account not only the relative size of the effect, but also how it affects the distribution of the educational indicator analyzed (Valentine and Cooper 2003). From this point of view, we see that it is small, since it is due to a rather weak difference (according to Cohen's criterion) in the bottom left of the distribution, or, put another way, the lowest achieving boys (first decile) do it a little worse than the lowest-performing girls (430 and 418 points, respectively), but in the rest of the distribution the differences between the two are practically insignificant. This result agrees with that found in other studies (Robinson and Lubienski 2011).

Table 5.1. Distribution of reading performance of girls and boys

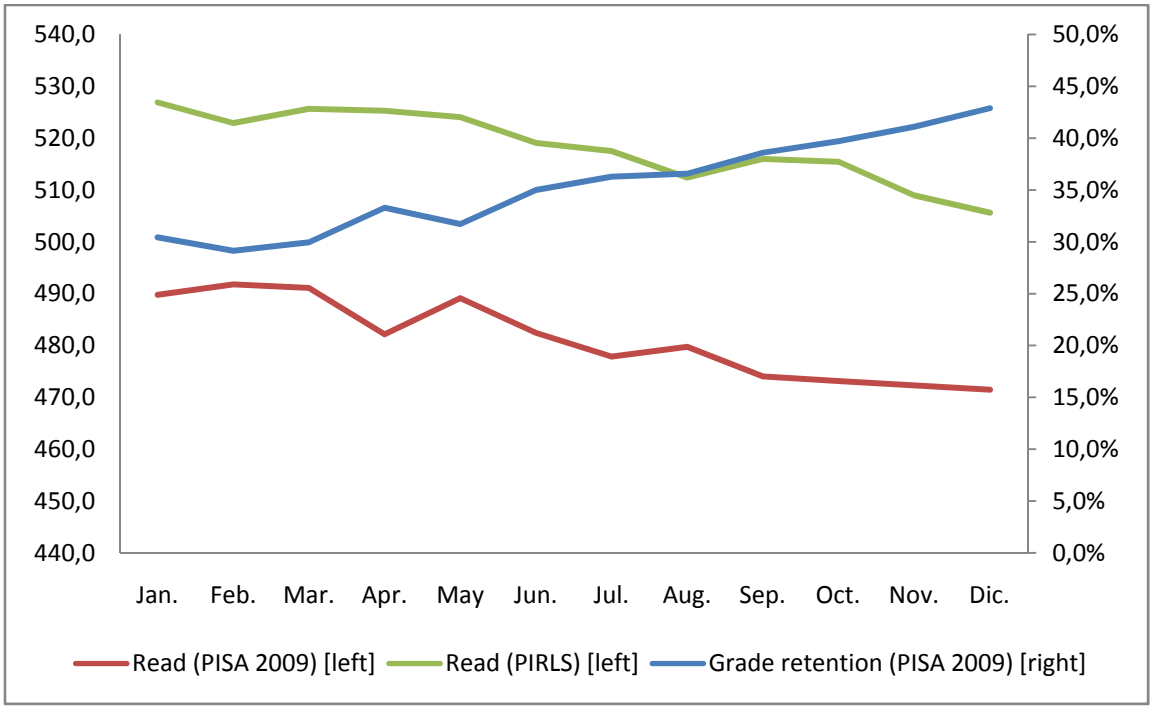
		Girls	Boys	Total
n		4.239	4.341	8.580
MeanMean		515,53	510,65	513,06
Standard error		0,98	1,00	0,70
Median		519,09	516,27	517,36
Mode		460,11	504,12	460,11
Stand. deviation		63,71	65,80	64,82
Minimum		304,19	311,05	304,19
Maximum		684,05	714,20	714,20
Percentiles	**5**	403,40	393,06	397,68
	10	430,23	417,92	424,51
	20	460,49	453,69	458,02
	30	481,93	481,08	481,57
	40	504,65	500,03	502,63
	50	519,09	516,27	517,36
	60	536,77	531,93	534,29
	70	552,62	548,65	550,51
	80	571,35	568,27	569,47
	90	594,53	592,46	593,74
	95	613,99	610,13	611,25

Source: PIRLS microdata

Month of birth

The month of birth is a good indicator of the cognitive maturity of children, because at age 10 (an age at which they are assessed in PIRLS) both physical and mental maturation processes happen quickly. Therefore, it is an approximation of cognitive ability, with the advantage that it does not relate to the social position, which is not so clear in the case of the measurements of intelligence tests (Fischer 1996). In Figure 5.1 we show the PIRLS as well as the PISA data, from which we can verify the importance of the month of birth. Using data from PISA, 30.4% of those born in January are in grade retention, while in December the probability rises to 42.9%. As for the scores[3], both in PISA and PIRLS we can see significant differences between those born in the first and in the last quarter, but in the intervening months the trend is not so clear. These data suggest the importance of cognitive maturity on educational performance, and how it can have an influence throughout compulsory schooling.

Graph 5.1. Reading performance at the age of 10 and 15, according to PISA 2009 and PIRLS 2011 (left axis), and percentaje of those who repeat a year at the age of 15 (right axis), according to PISA 2009, by month of birth



Source: PIRLS (2011) and PISA (2009) microdata [3]

We have grouped the months of birth together to better understand the linear trend towards worse results the later the months of birth. There is a category for those not born in 2001, who may have been born either before or after. Table 5.2 shows that the differences between being born at the start of the year and being born at the end is about 15 points.

[3] Scores of PISA and PIRLS are not directly comparable, especially since the standard deviation is 100 in PISA, but 65 in PIRLS, so that a difference of one point in PISA is equivalent to 0.65 points in PIRLS.

Table 5.2. Mean in reading by sex and month of birth

		Sex					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		Mean	S.E.	Mean	S.E.	Mean	S.E.
MESNAC2 Month of birth by sections	Student not born in 2001	466,1	3,10	465,8	2,90	465,9	2,14
	Student born between October and December of 2001	512,2	1,94	508,0	2,06	510,2	1,41
	Student born between April and September of 2001	519,6	1,40	519,0	1,46	519,3	1,01
	Student born between January and March of 2001	529,8	2,07	521,5	1,98	525,3	1,43
	Total	515,5	,98	510,7	1,00	513,1	,70

Source: PIRLS (2011) microdata

Educational level of the parents

We can see in Table 5.3 and Table 5.4 that both the educational level of the father and that of the mother make big differences in the school results of the children, about 100 points between the lowest and the highest. The trend is similar if, instead of splitting them, we create an indicator of the educational level of the family, as done by Blanco Fernández et al. (2012) in the accompanying research. We should note that educational homogamy is high (Table 5.5), and therefore the result will be similar if we choose to take parents separately or the family. But in this study, as we are interested in exploring the differences between girls and boys, and the possible influence of the parent of either gender, we have preferred to keep the two characteristics separate.

It doesn't show that the performance achieved by the students, according to the educational level of their mother and father, differs between boys and girls, although girls tend to do a little better in the lowest and highest levels of parental studies. In Table 5.5 we see that the effects of heterogamy (where the parents do not have the same level of education) are not very large. In subsequent multivariable analyzes, these differences are significant.

In the intermediate educational levels the differences between boys and girls [4] are not always statistically significant, so they proceeded to recode the educational levels by grouping the categories whose differences are not statistically significant together. In the case of women we have grouped them into the following categories: no schooling or without completed primary

[4] Observation is needed on how educational levels are encoded in the PIRLS questionnaire. Firstly, it should be taken into account that the parents of these children must have been born mostly between the early 60s and 70s, a period when the Education Act was in effect, but nevertheless, their level of studies has been classified according to LOGSE levels. This produces an anomaly in the mid-level studies, especially in the category which mixes Baccalaureate and Intermediate Vocational Training. It should be noted that the current Baccalaureate allows passage to higher education, but not in the case of Intermediate VT. Furthermore, one is academic training, while the other vocational. Therefore to consider them in the same category does not seem very appropriate.

education (including in this category the cases with missing information), CSE-GBS, IVT-VTII Baccalaureate, HLVT-Diploma, Graduates or higher. For men, we have encoded a little differently, attributing the lowest level to that of no schooling, and the rest are the same as in the case of mothers.

Table 5.3. Reading mean by sex and educational level of the father

		Sex					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		MeanMean	S.E.	MeanMean	S.E.	MeanMean	S.E.
ASBH17AR Level of studies of the father	Omitted or invalid	488,9	2,97	481,5	3,22	485,2	2,20
	No information	489,9	4,38	482,4	3,28	485,4	2,64
	Not applicable	485,6	14,09	502,0	11,20	495,3	8,76
	Without schooling	451,8	11,03	447,4	10,05	449,7	7,45
	Primary/CSE incomplete	501,8	2,68	494,8	3,26	498,3	2,12
	GBS/CSE	504,0	1,91	503,7	1,94	503,8	1,36
	Baccalaureate, IVT	521,5	1,92	521,4	2,12	521,5	1,42
	VT II	526,7	3,84	512,3	4,03	518,8	2,83
	HLVT	529,7	5,15	528,1	4,88	529,0	3,55
	Diploma	531,7	3,39	530,1	3,39	530,9	2,40
	Degree	561,0	2,66	550,5	2,59	555,6	1,86
	Total	515,5	,98	510,7	1,00	513,1	,70

Source: PIRLS 2011 microdata

Table 5.4. Reading mean by sex and educational level of the mother

		Sex					
		Girls		Boys		Total	
		Reading performance		Reading performance		Reading performance	
		Reading		Reading		Reading	
	Omitted or invalid	MeanMean	S.E.	MeanMean	S.E.	MeanMean	S.E.
ASBH17BR Level of studies of mother	No information	490,0	4,39	482,4	3,28	485,4	2,64
	Not applicable	498,9	12,09	471,2	15,07	483,8	9,99
	No schooling	481,6	7,83	477,1	17,75	479,9	8,33
	Primary/CSE incomplete	488,8	2,89	476,9	3,67	482,8	2,36
	GBS/CSE	500,8	2,02	502,8	1,89	501,8	1,38
	Baccalaureate, IVT	519,2	1,87	520,5	1,98	519,8	1,36
	VT II	528,5	3,78	515,2	4,09	521,9	2,80
	Higher VT	531,5	5,21	529,9	4,63	530,6	3,46
	Diploma	535,0	2,84	530,4	2,87	532,8	2,02
	Degree	556,7	2,41	550,9	2,77	553,9	1,83
	Total	515,5	,98	510,7	1,00	513,1	,70

Source: PIRLS 2011 microdata

Table 5.5. Reading mean by sex and educational homogamy

		Sex					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		MeanMean	S.E.	MeanMean	S.E.	MeanMean	S.E.
homoedu3 Educational homogamy	Homogamy	514,9	1,40	507,8	1,36	511,2	,98
	Hipergamy	511,1	2,01	506,6	2,06	508,8	1,44
	Hipogamy	520,8	1,85	521,8	2,04	521,3	1,37
	Total	515,5	0,98	510,7	1,00	513,1	0,70

Source: PIRLS 2011 microdata

Social class

Social class is, for sociologists, one of the most fundamental characteristics to explain the inequality of educational opportunities, both from the perspective of social reproduction (Bourdieu and Passeron 2001) and from the perspective of methodological individualism (Boudon 1983). In the first case, social class is important because of socialization, as people from different social classes value education differently, and their expectations may differ. For example, in the accompanying study by Blanco et al. we see that at the same level of educational performance, the expectations of parents that their children will go to university vary considerably depending on the level of family studies (one approximate way of measuring social class). Furthermore, the social classes with fewer resources lack the tacit knowledge and habits that are taken for granted in school. Therefore, the same level of demand by teachers may require a different level of effort from the students, depending on the social class of their family (Bernstein 1989; Mayoral 2005).

On the other hand, Boudon and his followers (Goldthorpe 2010) also believe that social background can make a difference in the effort required to pass school tests, as well as intelligence and other individual and family characteristics. But they believe that these factors produce a greater effect the lower the student's age. For this reason they call them "primary effects". Furthermore, they note that there are also side effects, which are those motivated by the assessment of the costs and benefits of studying. Also, in these side effects social position should be taken into account, since people from an upper class can't improve their position, but they can worsen it, and vice versa for the lower class people. Therefore, the cost of not studying is greater for people of middle and upper class, because if they don't do it they go down in social position, which doesn't happen for the lower class people. For the authors, these effects are more easily modified through public policies (such as scholarships and academic or career counselling) than the primary effects and, furthermore, have more weight when explaining educational inequalities, particularly in terms of their variations over time. In the present study, since the reference population is made up of 10 year-old children, the weight of the primary effects is greater.

The information collected in PIRLS is a little poor to allow us to accurately develop the social position indicators most used in the study of the inequality of educational opportunities, such as the social class model proposed by Goldthorpe (2010), the international socioeconomic

index of occupational status (Ganzeboom, De Graaf and Treiman 1992), used in studies such as that of PISA, or professional prestige scales (Carabaña and Gómez Bueno 1996). The intention of these indicators of social position is to understand the set of resources associated with the socio-economic integration of individuals and families. The advantage over monetary-type indicators is that they are a better approximation to permanent income (Zimmerman 1992). Furthermore, in the study of educational achievement they are also more sensitive to the influence of non-economic factors in educational decisions, as families of different class with the same level of income, and even equivalent levels of studies, can sway their educational decisions differently. For example, we see that in families with similar incomes and parents with secondary education, the children of parents with white collar occupations tend to study more than those of the blue collar parents (Gambetta 1987; Martínez García 2002).

With these limitations, we have gone on to group the occupations, trying to collect the three main axes of division in the social structure (according to Goldthorpe's model). These axes are the distinction between skilled and unskilled labor, manual and non-manual, and owners or managers against the other workers. To simplify the analysis we chose to take the higher position of either member within the couple. In addition, we took into consideration the sex of the person with better social position, distinguishing between homogamy, hypergamy and hypogamy. The results are shown respectively in Table 5.6 and Table 5.7. Table 5.6 shows that the higher the professional status, the better the performance in reading, which is similar for boys and girls. It is worth pointing out that the children of the few families in which neither parent has work experience, get a performance well below the other students, something which possibly reflects a type of situation very close to social exclusion. Among individuals from the primary sector or laborers (unskilled workers), skilled blue collar and small business owners, there are no statistically significant differences. However there are in the three following categories, in order: white collar, high-level officials/executives (or managers) and freelance professionals. Between this group and the block of the first three classes there are about 40 points difference (nearly two thirds of standard deviation).

As regards homogamy, it favors educational performance, something which may serve to support those who believe that educational success depends in part on the homogeneity of the social context in which socialization occurs (Martín Criado 2010). The lower performance in reading occurs in the case of hypergamy, although the differences are not very great.

Table 5.6. Mean in reading by sex and social class of family

		Sexo					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		MeanMean	S.E.	MeanMean	S.E.	MeanMean	S.E..
ocup2f Social class of family	No info	483,3	2,76	482,0	2,38	482,6	1,80
	No work experience	455,5	7,40	467,0	8,91	461,4	5,82
	Manual worker or primary sector	504,3	3,37	495,2	3,77	499,5	2,55
	Qualified blue collar	503,4	2,49	499,0	2,79	501,1	1,88
	Small owner	508,9	3,14	494,0	3,59	501,8	2,39
	White collar	517,4	1,60	518,5	1,61	517,9	1,14
	Executive/manager	533,8	3,76	529,0	3,60	531,4	2,60
	Professionals	548,2	2,11	544,2	2,20	546,2	1,52
	Total	515,5	0,98	510,7	1,00	513,1	0,70

Source: PIRLS 2011 microdata

Table 5.7. Mean in reading by sex and homogamy of social class

		Sex					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		Mean	S.E.	Mean	S.E.	Mean	S.E.
HOMCLF2 homogamy of social class	No info (of at least one)	495,5	1,80	490,6	1,76	492,9	1,26
	Hipogamy	525,4	1,83	520,5	1,88	523,1	1,31
	Hipergamy	518,1	2,16	515,3	2,24	516,7	1,56
	Homogamy	528,1	1,90	524,4	1,97	526,2	1,37
	Total	515,5	0,98	510,7	1,00	513,1	0,70

Source: PIRLS 2011 microdata

Economic activity of the mother

One of the most drastic social changes in the last quarter of a century in Spain, if not *the* most, is the increase of the participation of women in employment, as it has increased from 35% in 1992 to 53% in 2012; we are one of the OECD countries in which this incorporation has occurred most rapidly (Salido 2006). This is reflected in the PIRLS data since there are few women without work experience (6.1% of those for who we have information regarding their current or past occupation). Therefore, if there is a relationship between the mother's activity and the educational performance of the children, the weight of this relationship has gathered strength, allowing us to understand the overall educational results, by a simple effect of composition. Or put another way, if the economic activity of the mother influences educational performance, and economically active mothers are becoming more common, the effect of this characteristic will reach a higher proportion of children.

As in the other studies which we refer to in the background section, in Table 5.8 we detect a positive effect of the mother's economic activity, higher for girls than for boys. This result is maintained in the subsequent multivariable analysis, and is consistent with that found in the

aforementioned studies. The finding suggests either that the differential socialization hypothesis may be relevant in explaining the differences between girls and boys, or that some kind of characteristic exists that differentiates mothers with and without work experience, and which is associated with educational performance.

Table 5.8. Mean in reading by sex and by economic activity of mother

		Sex					
		Girls		Boys		Total	
		Reading		Reading		Reading	
		Mean	S.E.	Mean	S.E.	Mean	S.E.
madrein Mother has always been economically inactive	Active	517,1	1,00	511,4	1,01	514,2	,71
	Inactive	485,7	4,07	492,9	5,62	488,9	3,38
	Total	515,5	0,98	510,7	1,00	513,1	0,70

Source: PIRLS 2011 microdata

Educational practices prior to schooling

The educational practices prior to schooling are related both to school results and to the class position of the family and its educational level. But multivariable analyses show us that once this relationship is taken into account, they still have positive effects on educational performance. Since it has been studied in a qualitative way, families of low socio-cultural level with middle-class educational practices contribute to improving the performance of their children, though the material and cultural shortfallings hinder this work (Martín Criado et al. 2000). The pre-school practices that we have selected are: telling stories, playing letter games, word games, writing letters or words and reading signs and labels out loud.

In Table 5.9 we see a moderate correlation between this indicator and reading performance (0.219), which decreases by almost half when we remove the effects of the variables presented in the previous sections. That is, nearly half of the association of educational practices prior to schooling are due to socio-economic variables. But on the other hand, those practices associated with social position also produce effects when developed in the contexts of the more disadvantaged families, though more moderately.

Table 5.9. Correlations of Pearson between the level of reading and the modelled variables as variables of ratio

		Reading performance	**profe_i** Index of reading methods of teachers	pap_i Index of education practices prior to schooling	**rpap** residue for **pap_i**	**facil** Ability in reading	**rfacil** residue for easy	**INTSLEC** Index for interest in reading (residues of intsec)	**rints** Standardized residue for INTSLEC
Reading performance	r	1	,146	,219	,121	,373	,286	,291	,161
	p-value		,000	,000	,000	,000	,000	,000	,000
	N	8580	8580	7527	6477	8336	6317	8341	6231
profe_i Index of reading methods of teachers	r	,146	1	,047	,036	,087	-,004	-,009	-,022
	p-value	,000		,000	,004	,000	,758	,437	,077
	N	8580	8580	7527	6477	8336	6317	8341	6231
pap_i Index of education practices prior to schooling	r	,219	,047	1	,961	,100	,002	,110	,002
	p-value	,000	,000		,000	,000	,874	,000	,883
	N	7527	7527	7527	6477	7350	6317	7351	6231
rpap Standardized residue for pap_i	r	,121	,036	,961	1	,066	,003	,063	,003
	p-value	,000	,004	,000		,000	,799	,000	,800
	N	6477	6477	6477	6477	6317	6317	6323	6231
facil Facility in reading	r	,373	,087	,100	,066	1	,974	,249	,004
	p-value	,000	,000	,000	,000		,000	,000	,772
	N	8336	8336	7350	6317	8336	6317	8208	6231
rfacil Standardized residue for easy	r	,286	-,004	,002	,003	,974	1	,233	,005
	p-value	,000	,758	,874	,799	,000		,000	,673
	N	6317	6317	6317	6317	6317	6317	6231	6231
INTSLEC Index for interest in reading (residues of intsec)	r	,291	-,009	,110	,063	,249	,233	1	,940
	p-value	,000	,437	,000	,000	,000	,000		,000
	N	8341	8341	7351	6323	8208	6231	8341	6231
rints Standardized residue for INTSLEC	r	,161	-,022	,002	,003	,004	,005	,940	1
	p-value	,000	,077	,883	,800	,772	,673	,000	
	N	6231	6231	6231	6231	6231	6231	6231	6231

Didactic methods of the teachers in reading

We thought it appropriate to introduce a control on the teaching methods in reading, as this may affect how other variables influence educational performance, though only as a statistical control, and it is a matter which we will not elaborate on for reasons of space. We have developed a simple index, based on some teaching practices correlated to educational performance. These practices are as follows: the reading methods organized for each student individually by the teachers; the weekly frequency that teachers suggest they read books of fiction, drama and non-fiction articles; or the systematic teaching of new vocabulary to students. As shown in Table 5.9, the correlation with reading performance is significant but rather weak (0.14), and a little higher than the educational practices of the family, once their relationship to social background is discounted (0.12).

Interest in reading

In learning we are able to distinguish between two types of motivation: intrinsic and extrinsic (Carabaña 2005, Lumsden 1994, Meece, Anderman and Anderman 2006). Intrinsic motivation is that which deliberately seeks out learning because of the interest aroused by knowledge. On the other hand, extrinsic motivation is driven by rewards and sanctions, brings about learning which gels less, and is more easily forgotten upon passing the assessment tests. It is therefore important to take into account the interest of children for reading, since it contributes to their improvement in both the short and long term. The study of Tourón et al. (2012) finds a significant relationship between a liking for maths and performance, though it points out that the causality is unclear, possibly because both are influenced by similar processes. The variables that we have taken to develop this indicator are the degree to which the child agrees that it enjoys reading, whether they feel happy when they are given a book or whether they only read out of obligation.

The correlation of performance in reading with interest is moderate (0.291), and is almost halved when the effect of the socioeconomic variables is taken away. It should be pointed out that the correlation with the index of educational practices prior to schooling (Table 5.9), after discounting the effect of these variables, is low (0.06). That is, the net relationship between interest in reading and educational practices is low, once it is taken into account that both are influenced by social background, but it remains positive and significant. Put more simply, the net effect of the social background of the educational practices of the family improves performance in reading, but only slightly improves the appetite for reading.

Facility in reading

Consideration of whether children find reading easy is problematic, since the relationship with both variables is ambiguous. On one hand, we think that the relationship is causal, since, the easier it is to read, the better the performance will be. But on the other hand, we could think that ease and performance are two approximate ways of measuring a single characteristic, that of reading ability, and therefore it's not possible to talk of causality between the two. For

this reason, in the subsequent multivariable analyses it was decided to introduce it last, so as to better check what the effects are of the other variables without the ambiguities that could result in the inclusion of the characteristic itself as both a dependent and an independent variable. To the barrage of questions asked on this issue regarding children, we decided to add two more which we consider as having more capacity for discrimination, both in the multivariable and factor analysis: whether the students think that reading is more difficult for them than for their classmates, and whether the students believe that reading is more difficult than other subjects. In Table 5.10 we have presented the mean performance in reading, according to facility and educational level of the mother (one of the variables that makes more difference in performance). We can see that for all of the educational levels of the mother, the children who claim to have more facility are also those with the best performance. We can interpret this as meaning that children are more or less aware of their reading ability and that this ability produces similar effects at different levels of education of the mother, hovering around a standard deviation between the highest and lowest levels of studies. However, there are no differences between sexes with respect to how they perceive their own facility in reading and their mean performance in reading (see the analysis of variance in Table 5.A4. This suggests that boys and girls do not evaluate their reading ability differently, unlike what some studies have found in maths (Sainz and Eccles, 2012).

Table 5.10. Mean performance in reading according to the level of studies of the mother and indicator of facility in reading as declared by the boy or girl

		Level of studies of mother, grouped											
		No studies		CSE/GBS		Bacc-IVT-VTII		HLVT-Diploma		Graduates or higher		Total	
		Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Facility	Difficult	435,8	4,81	459,0	5,50	482,2	5,33	470,8	6,62	516,4	9,97	461,3	2,83
	2	450,4	6,34	470,3	5,46	488,4	6,29	506,7	6,05	527,0	7,89	477,8	3,24
	3	463,9	4,68	473,3	5,20	492,0	4,50	481,7	8,81	514,3	6,63	481,2	2,56
	4	467,0	3,17	490,6	3,64	504,5	3,54	505,1	5,73	524,9	7,46	491,7	1,92
	5	477,8	4,02	495,5	4,18	508,6	3,42	520,2	4,61	533,7	5,32	503,3	1,96
	6	491,8	4,54	511,3	3,72	525,5	3,15	541,8	4,67	544,5	4,58	521,8	1,93
	Easy	509,4	1,95	519,1	1,89	538,3	1,66	554,9	2,03	570,9	2,28	535,2	,93
	Total	485,4	1,42	502,2	1,40	520,9	1,24	533,0	1,76	553,9	1,85	514,2	,71

With this data it is not surprising to find that the correlation between reading performance and facility is the highest of those studied (0.37, Table 5.9), and that which drops least after checking for the effects of the previous variables. Their correlation is not statistically significant either with the pre-school practices or with the interest in reading, once social position is taken into account. Therefore it is possibly reflecting the most innate aspects of reading skills (related to reading performance, but not to social background, month of birth, sex or interest in reading). The variance analyses, shown in the Appendix, also suggest that the facility in reading captures a dimension of learning that is not associated with social background, since the η^2 is very low. But, on the other hand, we risk a possible artifact effect, both because it is not an ordinal but a ratio variable, and because its distribution differs considerably from the

normal distribution. Despite these drawbacks it seemed appropriate to keep it, for two reasons: these problems should affect the relationship of interest to the set of variables as a whole, but yet it correlates well with performance, and poorly with the rest; and, on the other hand, the Pearson correlations observed are close to the non-parametric correlations, which we have also estimated (ρ from Spearman and τ-b). The fact that there is a clear relationship between performance and an approximate way to measure ability begs the need for the performance studies, such as PIRLS, TIMSS or PISA, to be designed to more adequately measure this ability, and thus to avoid making attributions to other factors that may be indirect indicators of ability (Carabaña 2012).

Multilevel analysis

The data have been addressed through the regression analysis of means-as-outcomes (RMR) (Pardo, Ruiz and San Martín, 2007), choosing to include the different variables at the student and school level as fixed effects. We proceeded to introduce the independent variables in successive steps, as shown in Table 5.12.

The reference individual is made up of the mode of the modeled and qualitative variables, with the following result: a male student, with both parents who have a level of education corresponding to completed GBS or CSE, whose father works in a white collar job, and whose father and mother have a similar social class and educational level.

In order to facilitate the reading, the main results of all the adjusted models are reviewed below. Table 5.12 provides a summary which describes the main characteristics of the models, while Table 5.11 provides information on the final model which manages to get the best adjustment.

Table 5.11. Model with better adjustment (only statistically significant variables)

	Final model
Intersection	471,94** (89,91)
Fixed effects	
Month of birth	9,56** (11,13)
Education level Father 1	-33,34** (-4,80)
Education level Father 7	10,11** (5,03)
Education level Father 8	11,85** (4,10)
Education level Father 10	26,37** (6,81)
Mother without studies	-9,89** (-3,26)
Mother with GBS/CSE	-6,54** (-2,88)
No work experience	-25,04** (-5,05)
Class of family: Blue collar	-5,42** (-2,80)
Class of family: Small business owner	-6,85** (-3,13)
Educational hipergamy	-5,13** (-2,59)
Educational hipogamy	4,62** (2,15)
Girls with mothers with no work experience	-9,84** (-2,55)
Girls with university educated mothers	11,85** (3,59)
Index of family educational practices	6,00** (9,74)
Index of interest in reading	4,22** (10,49)
Index of teaching practices	1,49** (1,98)
Percentage of university educated fathers	0,38** (4,41)
Index of reading ability	2,02** (4,99)
Random effects	
Intra - school variance	2399,22** [60,90]
Inter- school variance	511,27** [8,35]
Percentage of intra school variance explained	23,77
Percentage of inter school variance explained	50,69
CCI	0,18
BIC	81439,39
-2LL	81421,52
N	8.582

Table 5.12 Summing up of the adjusted multilevel models

		% variance explained		Statistics of overall adjustment	
	CCI	Intra	Inter	BIC	-2LL
Void model	0,25	-	-	83679,47	83661,59
M1 Month of birth	0,24	5,79	7,67	83213,14	83195,26
M2 Sex	0,24	5,91	7,50	83201,29	83183,41
M3 Father's level of education	0,21	9,78	25,96	82829,86	82811,98
M4 Mother's level of education	0,20	11,90	33,29	82622,96	82605,08
M5 Social class	0,19	12,60	36,19	82522,61	82504,73
M6 Educational and class heterogamy	0,19	12,67	36,44	82495,61	82477,73
M7 Inactive mother	0,19	12,73	36,48	82478,41	82460,53
M8 Girls –hipergamy	0,19	12,72	36,50	82468,79	82450,92
M9 Girls – university educated mothers	0,19	12,78	36,40	82458,25	82440,38
M10 Family educational practices	0,19	13,72	37,46	82377,74	82359,87
M11 Interest in reading	0,19	15,49	38,16	82215,98	82198,10
M12 Teaching practices of teachers	0,19	15,45	40,54	82203,92	82186,05
M13: Percentage of university educated fathers	0,18	15,46	44,70	82186,30	82168,43
M14 Ability in reading	0,18	23,87	50,73	81385,31	81367,44

The estimated models are characterized by including information on the intersection (or mean of reading performance) within the fixed effects, as well as the parameters associated with different control variables. Its interpretation is the same as that performed by a general regression, ie: the estimated parameter indicates how much the reading performance changes for each unit that the independent variable varies. Along with this, in the random effects the co-variance parameters are included. The intra-variance (or that of the residues) reflects the variability that exists within the centers in the dependent variable. The inter-variance, on the other hand, tells us about the variability of the dependent variable between schools. The intraclass correlation coefficient (ICC) corresponds to the degree of variability between schools compared to the one between students of the same school. The null model, which does not introduce any control, shows that 25% of the variability total in reading performance is due to differences between schools; as we shall see as we introduce the control variables, that proportion will decrease progressively, so allowing better calibration of the proportion of variance which remains unexplained and which is due to differences between centers.

The first two models contain two "chance" characteristics of the students (there is no doubt that they are not caused by the other variables): the month in which they are born and their sex. Both variables have a positive impact on performance. Thus, students who are born in the first three months of the year get on mean 7 points more than those born between April and September and this group, in turn, has an advantage over those born between October and December of 7 points, or in other words, between the fact of being born in the first quarter and the last quarter, the difference is about one fifth of standard deviation. As we will see this variable maintains its significance in all of the adjusted models and, even more, its value increases slightly after the introduction of the different control variables.

In relation to the sex of the students, girls have a lead over boys of 3 or 4 points and the magnitude of this effect remains when controlled by variables related to socioeconomic background. However, this variable is no longer significant when an interaction between being a girl and having a mother with a high educational level is introduced as a control. That is, the small advantage in favor of the girls could be explained by the influence the mothers with higher educational levels (university studies) exert on their daughters.

Both the month of birth and sex are individual-level variables that have little impact on the intraclass correlation coefficient; after controlling these, of the total variability 24% can still be attributed to the centers, which means that schools do not not differ either by the birth month of their students or their sex. Alongside this, both variables (together) explain 7% of the variance between schools and 6% of the intra schools variance.

Models 3-6 incorporate variables related to the social background of students. Model 3 includes the father's educational level, in 4 that of the mother, in 5 the social class (highest) of both parents, while 6 reports on the conditions for hypergamy and hypogamy for the educational level and social class. The educational level of the fathers and mothers appears as a significant variable, whose influence remains relatively constant despite the introduction of different controls. The results show the existence of a clear and well known positive relationship between reading performance and the educational level of the parents. In relation to social class it confirms a clear negative effect of the situation of not having work experience which remains stable with the introduction of the different control variables. Also, if the highest social class of parents corresponds to blue collar jobs (as opposed to white collar which is our reference category) this also confirms a negative effect, though of lesser magnitude that of *not having work experience*.

With respect to situations of educational heterogamy and class, model 6 shows that children of mothers with lower educational levels than those of the father have a loss of about 5 points in the reading test, while the children of mothers with educational levels higher than the fathers "gain" 5 points (or 6 in the following models). That is, in situations of educational heterogamy those who are at a disadvantage are the children of fathers with a higher educational level than the mothers, while those who are at an advantage would be the students with mothers with a higher level of education than the father. Both variables maintain their significance in all adjusted models. This may be due to the greater role of mothers in child rearing, and therefore a higher qualification of mothers produces better academic results. With respect to the heterogamy of social class, significant effects are not seen on performance, so it does not support the view that growing up in a family environment with social differences between parents affects the educational performance (at least in reading).

The introduction of this block of variables which reports on the characteristics of the socioeconomic background of students has, as expected, an impact on the behavior of the inter school variance. Indeed, the introduction of the father's educational level implies an increase of 4 percentage points in explaining the intra school variance while the incorporation of the maternal educational level provides another two. Social class provides one percentage

point, while the heterogamy has no effect on it. Thus, while model 2 explains 6% of the intra school variance, Model 6, which includes all variables of social background, explains 13%.

These variables, on an individual level, have a significant impact on inter school variance. What can be expected is that the variables affect mainly the variance of the level for which they have been defined, so that the individual-level variables should affect above all the variance at intra school level. The fact that they have an influence on the variance between schools shows a certain degree of socioeconomic segregation between these or, put another way, if there is no similarity between them in the composition of the groups (schools) for individual explanatory variables, there will be a reduction of variance at inter school level. In that case, the individual variables will explain a certain proportion of both variances (Cervini, 2006). The introduction of the father's educational level increases the explanation of inter school variance from 7% to 26%, the incorporation of the mother's studies increases it by another 7 percentage points (reaching 33%), while social class provides another 3 percentage points (consideration of the educational and class heterogamy has no effect). Thus, the block of socioeconomic variables has allowed the explanation of the variance between schools to increase greatly, going from 7% to 36%. Along with this, the intraclass correlation coefficient has been reduced so that, controlling by month of birth, sex and variables that refer to the socioeconomic background of the students, 19% of the total variability may continue to be due to differences between schools.

Models 7, 8 and 9 explore the relationship that can exist between the sex of the students and their socioeconomic background. Model 7 introduces the interaction between the fact that mothers have always been inactive and the sex of the students. While having a mother who has always been inactive has a negative and significant effect for the girls, the same situation does not affect the boys. The behavior of these variables remains unchanged in the following models, so that daughters of mothers who have always been inactive get about 11 points less. The Model 8 introduces two interaction variables: daughters of mothers with a higher educational level than the father, and daughters of mothers with higher social class than the father. Neither of them is significant, and so, considering the effects of educational heterogamy, one can conclude that they don't affect boys and girls differently. Model 9 includes the interaction between being a girl and having a mother with a university education. This variable turns out to be significant and has a positive impact on the performance, leading to a gain of 10 points. But even more, as noted above, its introduction into the model makes the variable of sex insignificant. None of these models have an impact on the percentage of explained variance, nor on the intraclass correlation coefficient.

Model 10 introduces the index of early educational practices carried out by families, which have a significant and positive effect on student performance that remains stable in the following models. As discussed in the section on the description of variables, this is an adimensional index that doesn't allow an accurate estimate of the effect of such practices. However, it turns out to be significant even when controlled by variables of socioeconomic background, so that what families do with their children in early stages with respect to stimulating the learning process of reading is relevant, regardless of socioeconomic status (we also introduced an interaction between educational practices and social class and it didn't

come out as significant, ie: these practices affect children of all social classes equally). The introduction of this index does not mean a change in the intraclass correlation coefficient, but it does contribute to the explanation of intra and inter school variances (one percentage point each).

Model 11 incorporates an index that tells us about the interest shown by students towards reading, once the influence of social background on that interest is discounted. This index has a significant and positive impact on performance that remains in the following models. Thus, even after controlling by month of birth, gender, socioeconomic background and educational practices of the families, the interest that students may have for reading is relevant and has an influence on the results. This variable does not have an impact on the intraclass correlation coefficient, but it does have an effect on the intra and inter school variances, increasing each by one percentage point.

Models 12 and 13 incorporate variables of school level. The first introduces the index of educational practices, which is not significant after having been controlled by all variables. However, this situation changes on introducing one last variable related to the level of the student. Indeed, the introduction of this variable means a contribution to the explanation of the variance between schools equivalent to three percentage points. Model 13, on the other hand, take into consideration the percentage of university-educated parents in the school, ie: telling us about its social composition. This variable turns out to be significant and have a positive impact on performance in that for every 1% increase in the percentage of university-educated parents in a school, student performance increases by 0.36 points. As was to be expected, this variable does not affect intra school variance, but it does have an influence on the inter school variance, which is reflected both in the reduction of one percentage point of the intraclass correlation coefficient and the increase of inter school variance that the model achieves to explain.

As we already proposed, there is one last variable that we have controlled whose results are relevant. This is the index of facility of reading. This variable, on an individual level, turns out to be significant and have a positive impact on student performance even after making all of the previous controls. It also has an influence on the explanation of the inter school variance, which could be interpreted as a sign of segmentation between centers, this time, by ability of children. That is, the fact that this variable has an impact on the variance between schools would indicate that these differ in their composition in terms of the facility the students show in reading. Alongside this, we find that this variable has a truly remarkable impact on intra school variance: its incorporation allows it to increase by 9 percentage points. In one trial, this variable was introduced as the first and only control and its effect was similar to that pointed out, so that presumably it is related to reading achievement, but not to social background, family educational practices, teaching methods or interest in reading. Also it is worth noting that the incorporation of the index of reading facility affects the parameters associated with teaching practice so that this goes from being insignificant to significant. There is no doubt that this is an aspect that would need to be analyzed in greater depth in future studies, as it suggests that teachers' teaching methods help to improve performance, once the ability of the students is taken into account. In the adjustment of models both the Bayesian Information

Criterion (BIC) and the deviance (-2LL) indicate that the model that fits best is the one including all variables.

Is there a lot of segregation in schools?

The fact that Spanish schools differ in both the socioeconomic and academic composition of their students points to a certain degree of segmentation between centers in both dimensions. To know whether this segmentation is much or little, we need a comparative perspective. Given the similarities between PIRLS and PISA we can refer to this PISA report (2009) and bear in mind the conclusions that can be inferred from it. PISA creates two indicators: one of academic inclusion and another of social inclusion. In a socio-economically inclusive school system, the distribution of the socioeconomic characteristics of the schools reflects the distribution of the socioeconomic characteristics of the whole population (in each school the social composition of the country would be reproduced); on the other hand, if the schools attend to students who have similar socioeconomic characteristics to each other, the system is characterized by a low level of social inclusion. Similarly, academically inclusive systems are those where most of the variation in the performance of students occurs within the schools; if the variation in performance occurs to a greater extent between schools, that would indicate that students tend to be systematically grouped in centers with classmates of similar abilities (OECD 2010a).

The situation in Spain in terms of its rate of social inclusion is positive from an international perspective; in this case the social inclusion rate corresponds to 77, while the mean for OECD countries is 75. In other words, in terms of social inclusion Spain is slightly above the mean of the OECD countries. Regarding the rate of academic inclusion the data for Spain is even better since it corresponds to 78 while the OECD mean is much lower: 61. This leads us to conclude that even when in our analysis of PIRLS data we have found the existence of a certain degree of academic and social segmentation among Spanish schools, this should not be viewed with great concern in light of the data provided by PISA, since the rates of academic and social inclusion documented by this program put Spain above the mean of the OECD member countries.

DISCUSSION

The purpose of this research is to find out whether the large difference in Spain between boys and girls in administrative school failure in adolescence may be related to differences in reading during childhood. We have found that there are differences in favor of girls, but that they are small (0.08 standard deviations) and disappear once we take into account the positive effect on daughters of mothers with a university education and/or work experience. The latter has been found in numerous studies; in observational-type research, such as this, we can say that is consistent with three possible explanations. On the one hand, according to role theory, girls who see their mothers working may make more effort in school, believing that they

should play a more relevant role in the public realm, like their mothers. This may be a reasonable explanation at age 15, but maybe not so much at age 10. On the other hand, the families of mothers with work experience may raise their daughters differently. And finally, it may be that mothers who do not work have some sort of characteristic, not observed, which is related to both to participation in employment as well as with bringing up daughters. This could be because their gender identity leads them not to not give as much importance to the participation of women in public realm, that is, neither in the workplace nor in education, unlike the other women. Therefore, more research is needed to adequately discriminate between these alternative explanations. Summing up, it doesn't appear that differences in reading at age 10 are intrinsic to the sexes themselves, but to some factor related to the social characteristics of the mother, and the influence of this factor is too small to explain the fact that at 16 the school failure among boys is 10 percentage points higher than that of girls.

Moreover, while in PIRLS the advantage of girls of 10 years over their male classmates in reading is small, we know - through PISA data - that at age 15 this advantage has increased. Of course, the 10 year olds in 2011 are not the adolescents of 15 in PISA in 2009, so we don't know whether this difference will be maintained. If we assume that the 15 year old adolescents of 2016 will not be very different from those of 2009, we can conclude that the small differences in childhood are enlarged slightly in adolescence. Regarding the increase in these differences there are two possible explanations, which are not incompatible. On the one hand, on reaching adolescence the discrepancies between models of masculinity and femininity integrate the relationship with reading differently, since girls are more interested in reading than boys, something which has a positive influence on their reading skills (OECD 2010b). On the other hand, they may be due to the side effects (costs and benefits of studying) which are different for boys and girls, so that boys make less effort to improve their reading. If this is true, the policies aimed at reducing the gender gap in school failure could improve their effectiveness if they play a part in the balancing out of the conditions in the labor market and the sharing out of housework between men and women, so that the decisions of both are more similar with respect to their costs and benefits (Martínez García 2011).

To come to the conclusion that gender differences in reading are small, and due to social reasons, we have taken into account several characteristics that may be influencing the educational process. The study of these other characteristics also shows results relevant to educational policy. Firstly it's worth highlighting the relationship between month of birth and educational performance, both at age 10 and at 15, since the results of those born in December are worse than those who are born in January. This can be interpreted as evidence in favor of being more flexible about the start of compulsory education. It is striking to note the significance given, in the public debate, about flexibility around the end of compulsory education (career plans or passage to post-compulsory education), but also the absence of debate on the need for flexibility at its start, as happens in other countries. It is not just about adjusting the start according to the birth month (performance variability, measured in standard deviation, is almost the same by month of birth as for the whole population), but to the cognitive maturity of the children. To achieve this requires a certain qualification for the teachers of pre-school education which allows them to decide when students are mature

enough to go on to compulsory education, as well as the trust of the family in teachers to make this decision. If not, it could create a spiral in which parents pressure the teachers for their child to start as soon as possible, without regard to the future harmful effects of those decisions. The good thing about a measure of this kind, at a time of budget cuts, is that it is cheap and easy to apply, and helps to reduce student repetition and school failure, just as long as the possible aforementioned perverse effect is avoided.

We have also found that half of the observed variability that we can explain using the statistical procedures is due to the facility perceived by the children regarding their own reading. This variable is ambiguous, since it could be that the children who read better say that it's easier for them, or that those children with more cognitive ability find it easier to read and therefore have a better performance in reading. Since facility is not associated with social status, but performance is, we assume that is an approximate way to measure cognitive ability, as evidenced by the fact that it produces a similar effect among children of different social background (about one standard deviation between those of higher and lower educational levels of the mother). The ambiguity with which this variable can be interpreted, as well as its correlation with reading, shows the need for tests such as PIRLS to gather information on the ability of children.

Other results discovered are similar to those found in studies of this kind over the past half century: in addition to the ability of children, their social background is one of the most determinant factors, especially the educational level of the parents. This does not mean that there are other more important elements, but that in 50 years we haven't learned to measure much more effectively. The influence of social background is also noticeable in the social composition of the education centers: performance is better in schools with more university-educated parents. From the point of view of education policy this means that efforts should be concentrated in those schools where the socioeconomic and cultural status of the students is lower. Given the strong association between social background and educational performance, there are several experts who believe that educational and social policies should focus on paying attention to early childhood, especially pre-school education, to compensate children from the most disadvantaged social backgrounds (Esping- Andersen 2008; Heckman 2006). In order to calibrate the positive effect of these measures, we can bear in mind that among those children who say that they find reading easy, the mean score varies around a standard deviation between those who are children of mothers without studies and those whose mothers are university-educated (as seen in Table 5.10). Thus, as we achieve a more favorable socioeconomic and cultural context for these children, we will be able to improve the mean performance of the population in reading, while at the same time reducing inequality. Proof of this argument is that there is a negative relationship between the mean level of performance and inequality (measured as standard deviation), so that in those places where performance is higher, such as Finland and South Korea, inequality is less. In other words, if the inequalities were only down to ability and not also to social background, we would possibly have better performance and less inequality.

The other variables that we have included in the multivariable model gives us clues as to what kind of practices should be promoted in order to improve performance in reading, and more

specifically among students of lower social background. On one hand, part of the difference in social background has to do with the educational practices of the families. It is therefore advisable to encourage this type of practice among these families, although it is not an easy task precisely because of their low cultural level. As for the teachers, since it is not our speciality we can't say much more than what seems reasonable from a common sense perspective, and from the evidence provided. On one hand, it is positive that they encourage students' intrinsic interest in reading, and in that sense it is recommended that they adapt the suggested materials for each child according to their tastes. On the other hand, they should promote the use in class of different kinds of text (this is also a strategy that would give positive results according to PISA data). It is true that the association of these measures with performance is not as great as it could be, and may be due to the fact that our operationalization of these variables is clearly open to improvement, but they are easier to implement than improving the cultural level of the parents or the cognitive ability of the children. Furthermore, while positive and statistically significant effects can be seen, they can make the difference between struggling to read or enjoying books, so it's worth the effort.

The fact that the most influential factors in performance (social background and ability) seem difficult to modify may explain why, despite the fact that in recent decades in most OECD countries investment per student has increased, the results have not improved to the same extent, as noted in the study conducted by Tourón. The explanation may be in the observation of experts like Jencks and Phillips (1998) or Carabaña (2004) who consider that the policies which are easy to implement and of proven effectiveness have already been developed, and that the educational policies which are yet to be developed involve a more complex implementation and their results are more uncertain. Proof of this is that in the PISA tests the performance of students from countries has remained largely stagnant in the last decade, with few countries having improved or worsened. Furthermore, it should be noted that the countries which have improved were below the mean score in performance, while those which have worsened were above mean, and none of the two groups has crossed the mid-point. The difficulty of the task should not lead to dispondency, but to the hope of better understanding the educational processes, of experimenting based on rigorous scientific evidence and of promoting successful experiences. In promoting these experiences it should be taken into account that several studies on educational reforms show how these are exploited by the different agents involved to their benefit, distorting the original intention of the legislator, or in other words, the sociology of education reforms does not explain how reforms change the education system, but how the education system changes the reforms (Martin Criado 2010).

CONCLUSIONS

The differences in reading between boys and girls do exist, but they are small, and due to the fact that the economic activity of the mother and her level of education affects girls more positively than boys. Social characteristics and an imperfect indicator of ability (facility in reading as reported by the child) are the variables which are most closely related to

educational performance, and they affect both boys and girls equally (with the exception of what has been said about the mother). Part of the positive effect of social conditions has to do with the educational practices of the families from the higher social classes, which encourage reading, but if the families from the lower classes develop them they can also improve the performance of their children. The interest in reading is shown to be a factor that is also positive, though its relationship to performance can be complex (do children who do well in reading find it more interesting, or do they make more effort because they find it interesting?), but in case of doubt, it is worth encouraging this interest. So it's advisable to expose children to varied types of reading, and customize them based on their interests. It is also worth pointing out that it possibly helps to be flexible with respect to the start of compulsory education, so as not to penalize those whose cognitive development deviates from the mean.

We have detected that some of the differences between educational centers are due to the fact that within them families with different characteristics are brought together, but this social segregation is lower in Spain than in the neighboring countries, according to the evidence of other international studies. The importance of the social composition of the centers on educational performance suggests the need for programs of intervention tailored to compensate the children from families of the lowest educational level. Such measures do not seem to be easy, at least to develop them at a national level, since over the last decade there are many countries that have increased the investment in education and have made innovations in educational policies, but there are few that have improved, and some have even worsened.

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APPENDIX

Lost cases

The number of missing cases in the different analyzed variables is large. Not having these observations could significantly distort the study, because the sample which is finally selected would no longer be random, but the sample of the population from which we have information for all the variables. To address this problem, we have created a dummy variable when there is no information for each one treated as a ratio or interval. For nominal and ordinal variables, we have created a category in the variable itself, which indicates missing information.

Control of problems of endogeneity

The variables of parental educational practices prior to schooling, interest in reading and ability in reading are related to social background. Therefore, if introduced into the regressions, we could have difficulties in capturing the net effect of these characteristics, and it could be confused with social background. To avoid this problem we have proceeded to perform a variance analysis of each of these variables by social background, also taking into account the teachers' teaching methods, as well as the educational practices of the family, in the other two variables. After performing the variance analysis, we proceeded to extract the residuals, and use them in the regressions. In this way we have more confidence that the effects measured by these variables are not mediated by social background.

Table 5.A1. Variance analysis of the index of educational practices prior to schooling

Tests of the inter-subject effects						
Dependent variable: pap_i index of educational practices prior to schooling						
Background	**Sum of squares type III**	**gl**	**Quadratic mean**	**F**	**Sig.**	**Eta al partial square**
Corrected model	1940,426[a]	25	77,617	22,311	,000	,077
Intersection	16177,747	1	16177,747	4650,267	,000	,410
SEX	1,506	1	1,506	,433	,511	,000
homoedu3	15,280	2	7,640	2,196	,111	,001
ocup2f	432,992	7	61,856	17,780	,000	,018
HOMCLF2	20,750	3	6,917	1,988	,113	,001
madaca	9,147	1	9,147	2,629	,105	,000
madacav	4,515	1	4,515	1,298	,255	,000
MESNAC2	179,569	1	179,569	51,617	,000	,008
estudcp	64,241	5	12,848	3,693	,002	,003
estudcm	105,827	4	26,457	7,605	,000	,005
Error	23298,099	6697	3,479			
Total	374943,210	6723				
Total - corrected	25238,525	6722				

a. R square = ,077 (R corrected square= ,073)

Table 5.A2. Variance analysis of the index of ability in reading

Tests of the inter-subject effects						
Dependent variable: Ability in reading						
Background	**Sum of squares type III**	**gl**	**Quadratic mean**	**F**	**Sig.**	**Eta al partial square**
Corrected model	3793,621[a]	28	135,486	14,386	,000	,056
Intersection	10049,681	1	10049,681	1067,055	,000	,136
SEX	476,319	1	476,319	50,575	,000	,007
estudcp	112,964	5	22,593	2,399	,035	,002
estudcm	41,992	4	10,498	1,115	,348	,001
homoedu3	4,942	2	2,471	,262	,769	,000
ocup2f	393,976	7	56,282	5,976	,000	,006
HOMCLF2	110,661	3	36,887	3,917	,008	,002
rpap	156,627	1	156,627	16,630	,000	,002
mrpap	178,061	1	178,061	18,906	,000	,003
MESNAC2	435,780	1	435,780	46,270	,000	,007
profe_i	563,746	1	563,746	59,857	,000	,009
mprofe	,000	0	.	.	.	,000
madaca	15,101	1	15,101	1,603	,205	,000
madacav	,742	1	,742	,079	,779	,000
Error	63836,190	6778	9,418			
Total	439122,222	6807				
Total - corrected	67629,811	6806				

a. R square = ,056 (R corrected square = ,052)

Tabla 5.A3. Variance analysis of the index of interest in reading

Tests of the inter-subject effects						
Dependent variable: INTSLEC index of interest in reading (residuals of intsec)						
Background	**Sum of squares type III**	**gl**	**Quadratic mean**	**F**	**Sig.**	**Eta al partial square**
Corrected model	3627,072[a]	29	125,071	28,445	,000	,110
Intersection	13362,484	1	13362,484	3039,063	,000	,313
SEXO	742,608	1	742,608	168,893	,000	,025
estudcp	62,114	5	12,423	2,825	,015	,002
estudcm	35,205	4	8,801	2,002	,091	,001
homoedu3	8,508	2	4,254	,968	,380	,000
ocup2f	197,910	7	28,273	6,430	,000	,007
HOMCLF2	50,534	3	16,845	3,831	,009	,002
madaca	1,880	1	1,880	,428	,513	,000
madacav	21,554	1	21,554	4,902	,027	,001
rpap	117,756	1	117,756	26,782	,000	,004
mrpap	116,564	1	116,564	26,510	,000	,004
MESNAC2	106,781	1	106,781	24,286	,000	,004
profe_i	2,796	1	2,796	,636	,425	,000
mprofe	,000	0	.	.	.	,000
rfacil	,000	0	.	.	.	,000
mrfacil	,000	0	.	.	.	,000
Error	29358,166	6677	4,397			
Total	401834,000	6707				
Total corregida	32985,238	6706				

a. R square = ,110 (R corrected square = ,106)

Table 5.A4. Performance in reading, by level of studies of mother (grouped), ability in reading and sex

Tests of the inter-subject effects					
Dependent variable: READ performance in reading					
Origen	**Sum of squares type III**	**gl**	**Quadratic mean**	**F**	**Sig.**
Corrected model	7391777,539[a]	17	434810,443	135,784	,000
Intersection	9,916E8	1	9,916E8	309665,348	,000
SEX	2620,864	1	2620,864	,818	,366
lecfacil	3656963,885	6	609493,981	190,334	,000
estudcm	2878445,305	4	719611,326	224,722	,000
SEX * lecfacil	25697,724	6	4282,954	1,337	,236
Error	23654894,067	7387	3202,233		
Total	1,977E9	7405			
Total corrected	31046671,606	7404			

a. R square = ,238 (R corrected square = ,236)

Elaboration of variables

```
*******************************
STUDIES OF THE FATHER AND THE MOTHER.
*********************************************.
fre asbh17a asbh17b.
RECODE ASBH17A (9=0) (SYS =-1) (99=-2) (ELSE=COPY) INTO ASBH17AR
        /ASBH17B (9=0) (SYS =-1) (99=-2) (ELSE=COPY) INTO ASBH17BR.
VAR LAB ASBH17AR 'Level of studies of the father'
         /ASBH17BR 'Level of studies of the mother'.
val lab asbh17ar asbh17br
 -2'Omitted or invalid'
 -1'No information'
  0'Not applicable'
 1'Sin escolarización'
 2'Primaria/ESO incompleta'
 3'EGB/ESO'
 4'Bachillerato, FPGM'
  5'FP II'
 6'FP superior'
 7'Diplomatura'
 8'Licenciatura'.

fre asbh17ar asbh17br.
cro asbh17ar by asbh17br.

recode asbh17ar (1=1) (-2 -1=4) (0 2 3=5) (4 5=7) (6 7=8)  (8=10) into estudcp.
Var lab estudcp 'Padre, nivel de estudios (variable de razón)'.
cro asbh17ar by estudcp.

recode asbh17br (-2 thru 2=1) (3=3) (4 5=5) (6 7=6) (8=9) into estudcm.
Var lab esucm 'Madre, nivel de estudios (variable de razón)'.
cro asbh17br by estudcm.

**** homogamia educativa ****
AUTORECODE VARIABLES=estudcp estudcm
 /INTO estudcpr estudcmr
 /PRINT.
fre estudcpr estudcmr.
compute estudcpr=estudcpr-1.
```

```
cro estudcmr by estudcpr.
compute homoedu3=1.
var lab homoedu3 'Homogamia educativa'.
if (estudcpr>estudcmr) homoedu3=2.
if (estudcpr<estudcmr) homoedu3=3.

val lab
  homoedu3
1'Homogamia'
2'Hipergamia'
3'Hipogamia'.
fre homoedu3.
var lab homoedu3 'Homogamia educativa'.
fre homoedu3.

****ACTIVIDAD ECONÓMICA DE LA MADRE******.
recode asbh20b (1=1) (else=0) (sys mis=0) into madrein.
var lab madrein 'Madre siempre ha sido económicamente inactiva'.
cro asbh20b by madrein.
fre madrein.

COMPUTE madaca=0.
var lab madaca 'Madre inactiva e hija (inteacción)'.
if (madrein=1 & ITSEX=1) madaca=1.
fre madaca.
COMPUTE madacav=0.
var lab madacav 'Madre inactiva e hijo (inteacción)'.
if (madrein=2 & ITSEX=1) madacav=1.
fre madacav.

**** MODELO  DE CLASE SOCIAL  *****.
RECODE ASBH20A (1=0) (12=-1) (SYS=-1) (5 8=1) (6 7=2) (2=3) (3 4 11=4) (9=5) (10 =6)  INTO
OCUP2
         /ASBH20B (1=0) (12=-1) (SYS=-1) (5 8=1) (6 7=2) (2=3) (3 4 11=4) (9=5) (10 =6)  INTO
OCUM2.

VAL LAB OCUP2 OCUM2
          -1'Sin información'
 0'Sin trabajo'
          1'Trabajador no cualificado y del sector primario'
          2'Cuello azul cualificado'
          3'Pq. propietarios'
          4'Cuello blanco'
     5'Ejec./funcionario alto'
             6'Profesionales'.
cro ocupp by ocup2
   /ocupm by ocum2.

var lab ocup2 'Clase social del padre'
      /ocuM2 'Clase social de la madre'.
val lab ocup2 ocum2
          -1'Sin información'
 0'Sin trabajo'
          1'Trabajador operario o sector primario'
          2'Cuello azul cualificado'
          3'Pq. propietarios'
          4'Cuello blanco'
```

```
          6'Profesionales'
     5'Ejecutivo/funcionario alto'.
FRE OCUP2 OCUM2.

compute ocup2f=MAX(ocup2, ocum2).
var lab ocup2f 'Clase social de la familia'.
val lab ocup2f ocup2 ocum2
          -1'Sin información'
 0'Sin trabajo'
          1'Trabajador operario o sector primario'
          2'Cuello azul cualificado'
          3'Pq. propietarios'
          4'Cuello blanco'
          6'Profesionales'
     5'Ejecutivo/funcionario alto'.
FRE OCUP2F.

****HOMOGAMIA DE CLASE, MODELO FINAL****.
IF (OCUP2 = OCUM2) HOMCLF2=3.
IF (OCUP2 > OCUM2) HOMCLF2 =2.
IF (OCUM2 > OCUP2) HOMCLF2=1.
IF (OCUP2 = -1 | OCUM2=-1) HOMCLF2 = 0.
VAR LAB HOMCLF2 'Homogamia de clase'.
VAL LAB HOMCLF2 0'Sin inf. (de al menos uno)' 1'Hipogamia' 2'Hipergamia' 3'Homogamia'.
FRE HOMCLF2.
cro homclf2 by homclf.

VAR LAB HOMCLF 'Homogamia de clase'.
VAL LAB HOMCLF 0'Sin inf. (de ambos)' 1'Hipogamia' 2'Hipergamia' 3'Homogamia'.
FRE HOMCLF.

*PROFESORADO ******.
**************************
VARIABLES PROFESORADO
*******************************************.
Compute DPERSO  =atbr03d.
Compute DLIBEX  =atbr07ab.
Compute DTEATRO =atbr07ac.
Compute DARTI   =atbr07bc.
Compute DVOCAB  =atbr08f.

FRE DPERSO DLIBEX  DTEATRO DARTI DVOCAB.
COMPUTE PROFE= DPERSO+ DLIBEX  +DTEATRO +DARTI +DVOCAB.
VAR LAB PROFE'Métodos empleados por el profesor'.
FRE PROFE.
COMPUTE profe_i=(PROFE-7)/13*10.
recode profe_i (sys=-1) (else=copy).
VAR LAB profe_i 'Índice de métodos de lectura del profesorado'.
fre profe_i.

***FACILIDAD EN LECTURA***.
compute adifi1 = asbr08c.
variable labels adifi1 'alumno piensa que la lectura le resulta más difícil que a sus compañeros'.
execute.

value labels adifi1
1 Muy de acuerdo
```

```
2 Bastante de acuerdo
3 Un poco de acuerdo
4 Nada de acuerdo.

recode adifi1 (sys=1) (else=0) into adifi1m.
fre adifi1m.

compute adifi2= asbr08g.
variable labels adifi2 'alumno la lectura le resulta más difícil que otras asignaturas'.
value labels adifi2
1 Muy de acuerdo
2 Bastante de acuerdo
3 Un poco de acuerdo
4 Nada de acuerdo.

recode adifi2 (sys=1) (else=0) into difi2m.
fre difi2m.

compute lecfacil=adifi2+adifi1-1.
var lab lecfacil 'Facilidad con la lectura'.
val lab lecfacil 1'Poca' 7'Mucha'.
fre lecfacil.

compute lecfacil_i=(lecfacil-1)/6*10.
var lab lecfacil_i 'Facilidad con la lectura (índice)'.
fre lecfacil_i.

**********
******** PRÁCTICAS EDUCATIVAS DE LOS PADRE
**********.
COMPUTE PAPLET= asbh02d
COMPUTE PAPJUAL= asbh02g
COMPUTE PAPESC= asbh02h
COMPUTE PAPVOZ = asbh02i
compute pap=PAPCUEN+ PAPLET +PAPJUPAL+ PAPESC+ PAPVOZ.
fre pap.

compute pap_i=(pap-9)/*10.
recode pap_i (sys=-1) (else=copy).
recode pap_i (-1=1) (else=0) into papmis.
fre pap pap_i papmis.
```

Chapter 6

Students with High, Medium and Low Performance in Mathematics in TIMSS. Study of the Impact of some Contextual Factors

STUDENTS WITH HIGH, MEDIUM AND LOW PERFORMANCE IN MATHS IN TIMSS. STUDY OF THE IMPACT OF SOME CONTEXTUAL FACTORS

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INTRODUCTION

In 1998, the first evaluation of the education system based on IRT models (item response theory) was published in Spain, which was followed by many national and international studies, available on the National Educational Evaluation Institute webpage (http://www.mecd.gob.es/inee/). In that first study it was stated that "education systems currently represent, along with health systems, the largest enterprises of social intervention. Their results, directly or indirectly, affect all members of the community. Its proper functioning is therefore a matter of utmost importance and interest. This, perhaps, explains the high level of agreement about the need for a permanent diagnosis of the Spanish educational system" (Order Hoz et al., 1998, 17).

The evaluation, whether it is on a large scale, which is the present case, or through studies on a smaller scale, should provide elements which help to optimize the educational system and schooling in particular. Student performance, which is a more or less immediate manifestation of their learning, is produced in a particular environment, with certain school, family, and social determinants. "So, in this area of analysis, context questionnaires are usually a usual instrument that accompanies standardized performance tests. However, it is also true that in this type of instruments less attention is given to their design and development, meaning that in the end they are unable to provide explanatory value "(Jornet, Lopez and Tourón, 2012, 10). Despite the objective weaknesses of the contextual variables measurement, it is necessary to try to elucidate what their impact is, so that it's hopefully possible to act on some of them in order to improve the level of students' achievements.

In the report on the world's best education systems (Barber & Mourshed, 2007) it was clearly stated that, despite the fact that between 1980 and 2005 the investment in education in the US had grown 73% after taking away the effect of inflation, in the same period more teachers were hired, the teacher-student ratio decreased by 18% and in 2005 the class sizes in public schools was the lowest in history. The results of the students, however, measured by the national evaluation program of the Department of Education, had barely changed. The same

has happened in most of the OECD countries, where the available data indicate that, apart from in the early years of teaching; the reduction of class size does not have much effect on the student performance. Out of the 112 countries studied, only 9 showed a moderate positive effect, and in the other 103 the relationship between class size and performance is insignificant or negative. Despite the pessimism brought by some of the evaluation data and research on educational systems, we can ask ourselves: Is an improvement possible?

In a relatively recent study Mourshed, Chijioke and Barber (2010) pointed out that " However, we find that the vast majority of interventions made by the improving systems in our sample are 'process' in nature; and, within this area, improving systems generally spend more of their activity on improving how instruction is delivered than on changing the content of what is delivered.

A better education system is one that achieves an improvement in its students' results. And despite the evidence in the international evaluation studies, which appear to show the opposite, as we have seen, an improvement is possible and necessary. There is no doubt that the worse the results of an education system, the more the students will be adversely affected; both the ones with more ability, because they are the ones who will show a larger shortfall between their potential and their achievements, as well as the less able students since they can fail to reach a minimum level of competence that assures them an appropriate occupational or professional incorporation. Therefore it is important to study the impact of contextual variables on performance, paying attention to the groups at each extreme, as we shall do in this study, and not just in a generalized way.

The evaluation seeks the direct or indirect improvement of the evaluated object as its ultimate goal. So we should say that yes, improvement is possible, increasing the process efficiency, keeping the resources at an optimal level and investigating the factors that have most impact on the results and on the processes that make them possible.

"The extent to which a school system is able to realize the benefits of improved instruction depends on its ability to deploy it effectively; the system needs to ensure that every child, rather than just some children, has access to excellent instruction. Ensuring that every child benefits from high-quality instruction is not only an important end in itself, the evidence from international assessments suggests that strong performance for the system as a whole is dependent on this being the case"(Barber and Mourshed, 2007, p.34).

Along these same lines, the director of the PISA studies noted that "excellence in education is an attainable goal, and at reasonable cost (...). Success will go to those individuals and countries which are swift to adapt, slow to complain and open to change" (Schleicher, 2007, p. 6).

Throughout this the evaluation, as already stated, has an essential role, as do the studies and investigations arising from it. This is the driving motive of this study, and of the others accompanying this volume, of the TIMSS-PIRLS evaluation data, in which Spain has participated and which are long-windedly described in the volume on the description of Spanish results in TIMSS and PIRLS. It is the initiative of the National Institute for Educational Evaluation, already

present in the study of language competence (see INEE, 2012), that should be celebrated, because it will allow us to "go beyond" the evaluation itself, covering other objectives that are intrinsically unconnected to it.

In this research we tackle the study of the relationship between some of the variables available through the context questionnaires, both of the student and the teacher, and the level of student achievement, based on the groups of extreme performance defined below.

It is known that the Spanish education system, for reasons that are not relevant for this case (Tourón, 2011; Gaviria, 2003), has serious problems "pumping" students up to higher levels of performance. Thus, we see as an illustrative example in Table 6.1, taken from a recent paper (Tourón, 2012), that the percentage of students in the higher levels of performance in Spain are clearly below those of Finland and somewhat lower than those of the United Kingdom, and the opposite happens at the lower levels.

Table 6.1. Percentage of students at lower levels (<2) and higher levels (5-6) of the performance scale in PISA studies for the indicated years

		Finland		**United Kingdom**		**Spain**	
Year	**Subject**	**<2**	**5-6**	**<2**	**5-6**	**<2**	**5-6**
2009	Reading comp	8	**15**	18	**8**	20	**3**
	Maths	8	**22**	20	**11**	24	**8**
	Sciences	6	**18**	15	**11**	19	**4**
2006	Reading comp	5	**17**	19	**9**	26	**2**
	Maths	6	**24**	20	**11**	25	**7**
	Sciences	5	**21**	17	**14**	20	**5**
2003	Reading comp	6	**24**	N.D.	N.D.	23	**8**
	Maths	7	**24**	N.D.	N.D.	23	**8**
	Sciences	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

We must not forget, in any case, that the Law of Education of Spain in its article 1, sections b and e, says*: "The Spanish education system, configured according to the values of the Constitution and based on the respect for rights and freedoms recognized herein, is inspired by the following principles: (...). b. Equity, which guarantees equality of opportunity (...). e. The flexibility to adapt education to the diversity of skills, interests, expectations and needs of students, as well as to the changes experienced by students and society"*. And article 2 states, as its first objective, that *"The Spanish education system will be focused on achieving the full development of the personality and abilities of the students (...)".*

Our challenge is to make these principles a reality. Evaluation and research can be essential tools to achieve it.

The analysis of the impact on student performance of some of the context variables analyzed in this study tries to go one step further in this direction, in understanding the complex

relationships between context and results. It will not be possible to improve the result if we don't promote the factors that facilitate it and neutralize or cushion the impact of the factors which obstruct it.

METHODOLOGY

Since this is a secondary analysis of data from the TIMSS international evaluation database, as we have pointed out, the methodology used in this study is conditioned by its own nature. The TIMSS design responds to a complex pattern of measurement, which is why we have used the plausible values methodology (Wu, 2005, 2010) based on the previous studies of Rubin (1976, 1987, 1996) on multiple imputation and sampling design adapted to the structure of the population, which, for the calculation of standard errors of some statistics, requires resampling procedures appropriate for the object of the study.

The aim of this study is to characterize the influence of personal (student) and school (teachers) factors on Mathematics performance in TIMSS for three groups of students defined by their levels of achievement in this subject. The sample design of individuals and items involves using appropriate resampling procedures to obtain unbiased estimates of the errors associated with statistical estimates, and plausible values obtained from the a posteriori distributions for each individual , thereby ensuring that the size of the measurement error is not underestimated.

As is common in large-scale evaluations, along with the measurement of the level of achievement, a set of context questionnaires are administered and in the case of this paper we focus on those directed towards students and teachers. In this study we have used two different databases: one referring to students and the other to teachers. However, the measurement of the context variables, as already pointed out, is usually weak and each variable (item) alone does not make sense as an explanatory factor of performance, and contributes little to the explanation of the characteristic. For this reason we have developed factors or dimensions from the aforementioned questionnaires based on the grouping of items related to the same characteristic or aspect.

These dimensions have been considered as possible explanatory factors of academic performance in each one of the groups of students defined by their performance in the TIMSS Mathematics test.

Definition of the performance groups and Dependent Variable

The response variable in this study is the score obtained in Mathematics. Essentially, rather than obtaining a specific estimator of the measured skill for each student, we get an a posteriori distribution for each one, from which 5 values, called Plausible Values, are randomly taken. This procedure has the advantage of allowing a better estimate of the variance of the measurement error, so that the probability of type I errors decreases by making inferences

about the population average and other values. In exchange we don't have a single value for each individual; in fact, two students with the same set of answers can have different sets of plausible values, with different means. Therefore all statistical analyses performed with these variables differ from the standard procedures that are usual in conventional statistical packages.

In this study we work in parallel with three groups of students representing three clearly distinct performance levels: high, medium and low, analyzing the performance of the extreme groups. The definition of the performance level was made by selecting the top, middle and bottom 10% of the distribution of students Mathematics scores, setting the cut-off points as those corresponding to Pc 10 (for the lower group), Pc 45 and 55 (for the middle group) and Pc 90 for the top group. Table 6.2 shows the mean and other descriptive values of the groups.

This classification is only used to determine three groups that we understand as being different in nature. The response variable included in the inferential analyses is of a continuous nature given that they are determined by the plausible values of each student within each group.

Table 6.2. Descriptive values of performance groups in Maths used in this study

Groups	Cut-off scores	Mean	Sd	SE	Min	Max	N	N weighted
Low	≤ 399,94	367,54	38,89	3,43	245,45	399,89	426	48942
Medium	482,72 - 499,22	490,75	23,11	1,55	482,72	499,21	419	40684
High	≥ 571,82	595,88	29,86	1,90	571,83	676,96	418	37168

Because of the complex sampling methodology adopted in TIMSS, the size of each group must be weighted so both values of N are attached in Table 6.2.

Independent Variables: Construction of dimensions

In a first phase of analysis of questionnaires of students and teachers, we proceeded to perform a Principal Component Analysis (PCA) for ordinal variables in order to detect the configuration of dimensions from the individual items. The dimensions detected through this analysis, which are not included here for reasons of space, were later contrasted through a confirmatory model which is described below.

Once the PCA is done, in order to carry out the construction of the dimensions that would be used as independent variables in this study, based on the items of the context questionnaire applied to students and teachers, we have used the Item Response Theory for polytomic items. Specifically, the Rasch simple logistic model using the Partial Credit Model (PCM) of Masters (1982). This model estimates a parameter of "*difficulty*" (parameter b) for each step inside the item and which can differ between items.

The Rasch models (1960) assume that the scores of the individual in the measurement instrument, defined as the total sum of the individual's answers to the set of items and the

item score (difficulty), defined as the sum of all the individual's answers in an item, are statistics sufficient for estimating the parameters of the model. Contrary to what happens in the Thurstone models, which estimate the same value of the characteristic for the individuals who get the same scores in the test. In the Rasch model the discrimination of the items is considered constant and equal to 1.

In multiple choice items that have one correct answer, the existence of random right answers is highly probable, as well as the variation of the indices of discrimination (Muñiz, Rogers & Swaminathan, 1989). However, in polytomic items, as is the present case, the estimation of these parameters turns out to be dispensable, notably improving the parsimony of the model. Therefore, the probability of an individual's answer to a particular item depends solely on these statistics (estimated trait and difficulty of the item). In the case of dichotomous items it is:

$$P(\theta) = \frac{\exp D(\theta - b)}{1 + \exp D(\theta - b)}$$

Where $P(\theta)$ is the probability of getting the item right for a given latent trait value (θ). *D* is a constant, equal to 1.7, which approximates the values to the normal distribution. *b* is the parameter of difficulty, or the level of characteristic necessary to respond to the item correctly, or in other words, that value of ability at which the probability of getting the item right exceeds 0.5. In polytomic models it is the level of trait necessary to complete that step or category within the item.

Polytomic models are characterized by estimating a parameter of difficulty for each of the response categories of the item. This strategy was devised by Samejima (1969) who, in his models for graded response items, starts with the calculation of the so-called Characteristic Curves of Category (CCC), originally applied to two-parameter models. In the case of the PCM, these parameters can vary between items; in other polytomic models like the Rating Scale (Andrich, 1978) the parameters of the categories are the same for all items.

The Partial Credit Model of Masters (1982) assumes that the probability that the individual completes each step or category of the item can be explained by a Rasch model. In our case, an item with six response categories (r = 0,1,2,3,4,5) would be formulated as follows:

$$\sum_{h=o}^{R} \exp\left(\sum_{r=0}^{h} (\theta - \beta_r) \right), \text{ where by agreement } \sum_{r=0}^{0} (\theta - \beta_r) = 0$$

Where *P (r)* is the conditional probability so that an individual is placed in category *r* of an item according to a particular level of ability; *h* identifies each one of the steps produced within the item; the total number of steps or possible stages within an item that is equal to the total number of categories minus one (*R*); and β_r is each one of the parameters of difficulty in each category of the item, and it has a different meaning to the difficulty of the Rasch model for dichotomous items (*b*), since it does not refer to the difficulty of the item, but to the difficulty

of reaching a step within that item. They represent the point at which the probability of selecting a category changes, and can be interpreted as relative difficulties of the different steps. In other words, how much of the trait is required to move from one category to the next (Martínez, Hernández and Hernández, 2006).

The case of multidimensional models is an extension of the above equation. It is assumed that there is a set of *D latent* traits, in this case 5 latent dimensions that are implicit in the student answers. The feature becomes a vector with D dimensions $\theta = (\theta_1, \theta_2, ..., \theta_D)$. (For more detail, see Ackerman, Gierl and Walker, 2003 and Kennedy, 2005).

To estimate a multidimensional model it is necessary to use Monte Carlo integration, due to the large number of latent dimensions that comprise it. The use of this methodology for a model with more than three dimensions is recommended, while with a smaller number of dimensions the use of maximum likelihood or quadrature method is recommended (Wu, Adams, Wilson & Haldane, 2007).

The scores of the individuals in each of the dimensions of the trait are calculated using the A Posteriori Bayesian Expected Estimator (ABE). This type of estimation can be seen in more detail in Wu, Adams, Wilson and Haldane (2007).

To check the goodness of fit of the items, statistics based on residuals such as the difference between the empirical answer and the expected probabilities are used. Quadratic means of these residuals are calculated; whose distribution also approximates to χ^2 and their mathematical expectation is 1. If this value (=1) is obtained from the statistics, the item has a good adjustment fit to the proposed model. The statistic is also transformed to the normal distribution as proof of hypothesis T (values above 2 indicate bad adjustments). In the results, this statistic is presented in two different ways:

- MNSQ (unweighted): it doesn't weight the residuals, so that it represents the external adjustment because it is sensitive to the unexpected behavior of items whose gradient moves away from the individual's ability level, ie: individuals with a high level of ability who value low categories, or vice versa.
- MNSQ (weighted): it is the same index but weighted by the amount of information of an item in the interval of ability. It corresponds to the internal adjustment, fits the items with irregular answer patterns implicit in people, and vice versa, because people with a trait level close to difficulty have more influence on the residual.

Both indices are presented in a non-standardized way as a quadratic mean with a confidence interval of 95%, and as a hypothesis test (T) in a standardized way. It has already been mentioned that the perfect value of adjustment is when the indices are equal to 1, but the values are acceptable as long as they don't exceed the limits of the interval of confidence, or the T test exceeds the value of 2. If the value is above, the category has more variability than that expected by the Rasch model and if it is below, then it has less variability than expected. The degree of adjustment of the items is shown in the appendix to this study.

The independent dimensions constructed by this procedure from the student context questionnaires are described in Table 6.3.

Table 6.3. Factorial dimensions produced from the student questionnaire

INDEX	ITEMS	CONTENT
Posessions at home	ASBG04	Amount of books in the home
	ASBG05A	Computer
	ASBG05B	Study desk
	ASBG05C	Having own books
	ASBG05D	Own room
	ASBG05E	Internet conexion in the home
Bullying	ASBG09A	Laughed at me
	ASBG09B	Left me out of games or activities
	ASBG09C	Someone told lies about me
	ASBG09D	Got robbed
	ASBG09E	Beaten or harmed by others
	ASBG09F	Forced me to do things I didn't want to do
Liking for Maths	ASBM01A	I enjoy learning Maths
	ASBM01B	I would like not having to study Maths
	ASBM01C	Maths is boring
	ASBM01D	I learn interesting things
	ASBM01E	I like Maths
	ASBM01F	It's important to do well in Maths
Perception of Maths class	ASBM02A	I know what the teacher expects me to do
	ASBM02B	I think about things unrelated to the class
	ASBM02C	It's easy to understand the teacher
	ASBM02D	I'm interested in what the teacher says
	ASBM02E	My teacher gives me interesting things to do
Self-confidence in Maths	ASBM03A	I normally do well in Maths
	ASBM03B	It's more difficult for me than for others
	ASBM03C	I'm not good at Maths
	ASBM03D	I learn things quickly in Maths
	ASBM03E	I do well with difficult problems
	ASBM03F	My teacher says I'm good at Maths
	ASBM03G	Maths are more difficult than the other subjects

Independent dimensions constructed by this procedure from the teacher context questionnaire are described in Table 6.4.

Table 6.4. Factorial dimensions produced from the teacher questionnaire

INDEX	ITEMS	CONTENT
Satisfaction and support in the school	ATBG06A	Teachers' satisfaction with their job
	ATBG06B	Teachers understanding of the curricular objectives
	ATBG06C	Teachers' level of success in implementing the curriculum
	ATBG06D	Teachers' expectations about the students' performance
	ATBG06E	Parents' support on the students' performance
	ATBG06F	Parents' involvement in school activities
	ATBG06G	Respect of the students for the school facilities
	ATBG06H	Students desire to do well in school
School climate	ATBG07A	Located in a safe neighborhood
	ATBG07B	I feel safe at school
	ATBG07C	Adequate school security measures
	ATBG07D	Students behave in a disciplined way
	ATBG07E	Students are respectful towards their teachers
Facilities for professional development (inverse)	ATBG08A	The building needs major repairs
	ATBG08B	Classes have too many students
	ATBG08C	Teachers have too many teaching hours
	ATBG08D	There is no suitable space for the teachers
	ATBG08E	There is no appropriate educational or school material
Use of Computer and Tech.	ATBG09BA	I feel comfortable using computers in class
	ATBG09BB	If I have problems I can go to technical support staff
	ATBG09BC	I get support for the integration of computers to teaching
Interaction with other teachers	ATBG10A	Discuss how to teach a subject
	ATBG10B	Collaborate in the planning and preparation of teaching materials
	ATBG10C	Share what I've learned from my teaching experience
	ATBG10D	Visit other classes to learn about my teaching
	ATBG10E	Teamwork to try new ideas
Professional satisfaction	ATBG11A	I am satisfied with my profession
	ATBG11B	Being a teacher of this school satisfies me
	ATBG11C	I had more enthusiasm when I started teaching than now
	ATBG11D	I do an important work as a teacher
	ATBG11E	I intend to continue teaching for as long as I can
	ATBG11F	I feel frustrated as a teacher
Teaching Limitations	ATBG16A	Students with lack of previous knowledge
	ATBG16B	Students with basic nutritional deficiencies
	ATBG16C	Students with lack of sleep
	ATBG16D	Students with special needs
	ATBG16E	Problematic students
	ATBG16F	Students with lack of interest

Data Analysis Plan

The database used has finally linked the values of each student in the dependent variable (performance in Mathematics) with the corresponding values to the 12 independent dimensions constructed, as previously explained.

The estimation of the error variance in TIMSS uses a resampling procedure, in this particular case a variant of the Jackknife method known as JRR or JK2. For performance in Mathematics this procedure uses a single variable to generate replicas. This methodology allows a better estimation of the sampling variance of each estimator.

Given that 5 plausible values correspond to each dependent variable for each register of the database, the estimation of measurement and sampling errors reaches a certain level of complexity. On the other hand, the TIMSS data presents a nested structure so that, as Chong (2012) points out, the analytical focus of classical regression using common least squares (OLS) is inadequate, given that it is unlikely that the residuals are independent from one another. For this reason, a mixed linear model with repeated measurements (MLM) has been used in which the five plausible values are included as the only dependent variable in the model.

An MLM is a parametric linear model for nested or longitudinal data, or for repeated measurements that quantify the relationship between a continuous dependent variable and several predictive variables. The 5 plausible values of the variable of performance can be considered as nested scores within a student. To deal with this structure the intra-students residual matrix has been defined as an identity matrix. In this way the covariance's between the different plausible values are avoided and a common variance is estimated.

These models can include fixed parameters of effects associated with one or more covariables, and random effects related to one or more levels of variance (students, teachers, schools, etc.). While the fixed effects parameters describe the relationship between the covariables and the dependent variable for the entire population, the random effects are specific for groups or individuals within a population.

To perform mixed linear analyses two levels of aggregation are considered: the different plausible values nested in each subject as the first level, and the students as the second level.

Following the Henderson's general model of mixed equations, it is formulated as follows:

$$Y = X\beta + Zr + e$$

Where Y is the whole vector of performance scores which are included in the model with $n \times 1$ scores observed for each individual, in this case the five plausible values; X is a known matrix with a $n \times p$ design; β is a p dimension vector which represents the different fixed effects and r is the random effects vector with dimension q; Z is a $n \times q$ dimension matrix associated with the r random effects; and e is a random non-observable $n \times 1$ vector which represents the variation without considering, in other words, the error distribution, with normal distribution and constant variance.

An example of a single individual MLM, and therefore without random effects, is as follows:

$$Y = X\beta + e$$

$$\begin{vmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \end{vmatrix} = \begin{vmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{vmatrix} |\beta_0| + \begin{vmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{vmatrix}$$

With this structure the β_0 coefficient is the estimated mean score in the five plausible values and, in this example, is considered to be a fixed parameter. By incorporating more individuals in the analysis, this coefficient also incorporates random variance between students.

$$Z\,r + |e| = \begin{vmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{vmatrix} |r_1| + |e|$$

This model without covariates is the null model:

$$y_{ij} = \beta_0 + r_1 + e_{1j}$$

Where: i=1,2,3,4,5 y j=1,2,…,M (M individuals of the sample). And where $e_{ij} = \left(N\left(0, \sigma^2\right)\right)$

and $r_1 = \left(N\left(0, \sigma_r^2\right)\right)$

The dimensions of the teacher and of the students themselves are introduced as fixed coefficients in this model:

$$y_{ij} = \beta_0 + \beta_1 x_{1j} + \ldots + \beta_{12} x_{12,j} + r_1 + e_{ij}\; y_{ij} = \beta_0 + \beta_1 x_{1j} + \ldots + \beta_{12} x_{12,j} + r_1 + e_{ij}$$

Calling $x_1, \ldots, x_{12}$ those variables which include the 12 dimensions . J=1,2,…, M. Where

$e_{ij} = \left(N\left(0, \sigma^2\right)\right)$ and $r_1 = \left(N\left(0, \sigma_r^2\right)\right)$

RESULTS

Each of the dimensions that it was possible to estimate from the student and teacher questionnaires were defined in Tables 6.3 and 6.4. For each of these dimensions the factorial

scores for each student were estimated, so that from these the mean values for each dimension for each performance group were calculated, as shown in Table 6.5.

Also, a one-way analysis of variance was made, taking performance as the independent variable, according to the three groups mentioned above, and using each of the factorial dimensions obtained as the dependent variable. All dimensions, both of the students and the teachers, revealed significant differences between the groups, as indicated in the column of significance.

Regarding the students, we see that the dimension that presents the greater differences between the extreme groups of performance is that of *Self-confidence in Mathematics*. This difference in units of standard deviation is 1.42 (-0.62 to 0.80), which expressed in other terms means that high performance students have their average around the 79th percentile, and those with low performance around the 27th percentile. It seems reasonable that students who do well in this subject have a good sense of their own competence and ability to meet the challenges of their learning in that subject, their facility of learning or their ability to solve difficult problems. The opposite happens with the students who do worse or get worse performances, although there is a peculiarity that will be addressed later.

The second dimension in terms of the magnitude of the differences between the extreme performance groups is that of *Liking for the subject* (1.10 standard deviation units) which, expressed in percentiles, means that students with low performance have an mean in the 33rd percentile and those with high performance in the 74th. The positive dimensions of this factor have to do with the enjoyment of learning, the importance of doing well in the subject or in valuing the things learned as being interesting. These two dimensions are not independent, since the perception of one's own ability to perform well, or the attribution of good performance to one's own ability leads one to appreciate what is learned, so that the ability-performance-liking for what is learned show, in all probability, a multiple and bidirectional causation.

The next dimension, which shows some differences, but clearly lower than those above (0.64), is the *Level of possessions in the home*. Again this dimension is usually an indirect indicator of other circumstances of family and social context in which the student develops. Students with worse performances have their average in this dimension in the 37th percentile and those with higher performance in the 63rd.

With minor, though statistically significant, differences is *Perception of the Class*, which is defined by the class understanding and the recognition of the teacher's expectation on what the student must do or on the interest on the assignments that the teacher sets for the students (Table 6.5). Students with the worst performance have their mean in this dimension at the 42nd percentile, while the students with better performance have theirs in the 58th.

Finally the factor we call *Bullying* appears, which has a lower impact, probably because students do not feel the threats that define the factor - which is something positive. However, here the students with worse performance have a slightly more negative perception, their

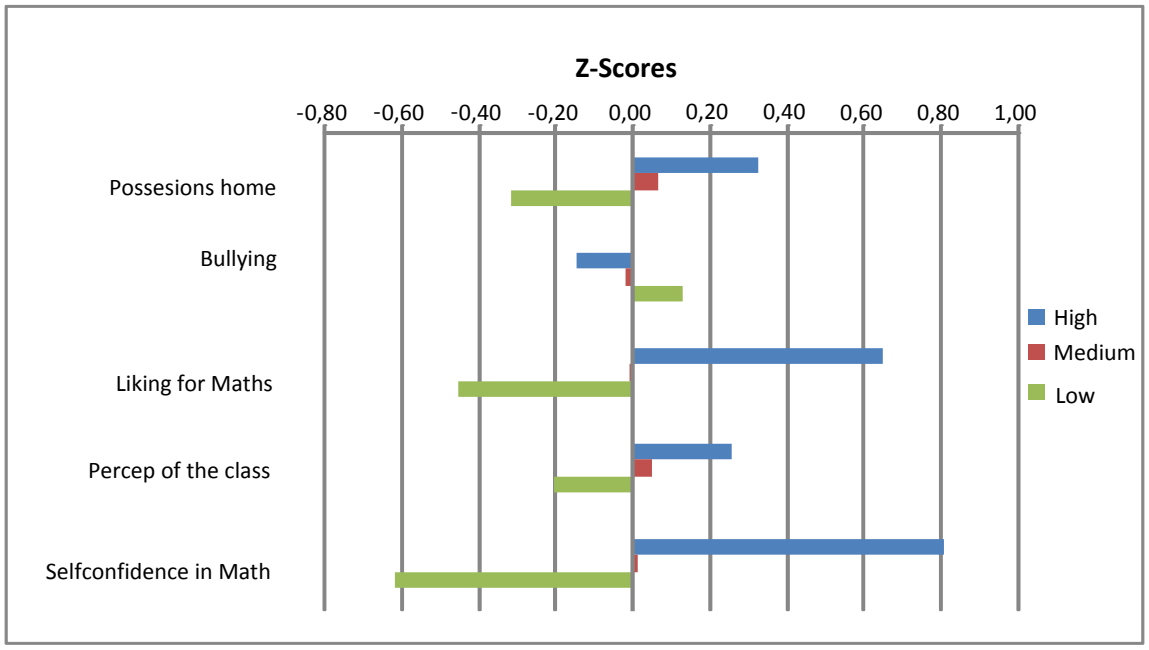
average being in the 55th percentile, while the students with better performance are in the 44th percentile. This result, which is perhaps not so relevant from a practical point of view, would indicate that the best students in terms of performance in Mathematics are bullied less than those with worse performance. We have no data to be able to give a full explanation for this result, but it seems to indicate two things: that doing well in school is not a cause of bullying by other students and that, overall, bullying did not appear to be a major problem for this group of students. Other studies, such as the one developed by Perse, Kozina and Leban (2011) analyze the TIMSS data from Slovenia and show a significant negative relationship between aggressive behavior and the results in Mathematics and sciences.

Table 6.5. Mean values and significance of the differences between performance groups for the dimensions calculated from the student questionnaire

Dimensions	Performance	N	Mean	Stand. Dev.	Minimum	Maximum	Signif.
Possesions in the home	**Low**	48942	-0,32	0,45	-1,39	0,88	0,000
	Medium	40684	0,06	0,39	-1,56	1,21	
	High	37168	0,32	0,37	-1,14	1,47	
	Total	126794	-0,01	0,48	-1,56	1,47	
Bullying	**Low**	48942	0,13	0,65	-1,35	1,95	0,000
	Medium	40684	-0,02	0,64	-1,35	1,51	
	High	37168	-0,15	0,60	-1,30	1,75	
	Total	126794	0,00	0,64	-1,35	1,95	
Liking for Maths	**Low**	48942	-0,45	0,99	-3,42	2,47	0,000
	Medium	40684	-0,01	1,11	-3,71	2,55	
	High	37168	0,64	1,02	-1,71	2,66	
	Total	126794	0,01	1,13	-3,71	2,66	
Perception of Maths class	**Low**	48942	-0,21	0,47	-1,94	1,40	0,000
	Medium	40684	0,05	0,59	-2,07	1,35	
	High	37168	0,26	0,60	-1,69	1,41	
	Total	126794	0,01	0,58	-2,07	1,41	
Self-confidence in Maths	**Low**	48942	-0,62	0,73	-2,74	1,81	0,000
	Medium	40684	0,01	0,89	-2,26	2,21	
	High	37168	0,80	0,78	-1,18	2,39	
	Total	126794	0,00	0,98	-2,74	2,39	

Figure 6.1 shows the representation of the average values according to performance groups, where we can clearly see what was pointed out earlier*: Self-confidence in the subject, Liking for the subject* and *Possesions in the home* are the three dimensions which most differentiate the students by their performance, while *Bullying,* as described above, and *Perception of the Class* have less relevance for the extreme groups.

Figure 6.1. Mean values of the dimensions of the student questionnaire according to academic performance



We have previously said that the students' and teachers' databases were joined together in a way that the teacher's answers from the corresponding questionnaire are associated to their students. With respect to the dimensions calculated from the teachers' questionnaire, the one that shows greater differences is the one we have called *School climate* and it is defined, as shown in Table 6.4, by items related to the safety of the center depending on its location, security and discipline measures, behavior and respect of students towards the teachers. The differences are noticeable and significant. So, teachers of students with low performances have the average in this dimension at a value equivalent to the 17th percentile, while teachers of students with high performances are in the 72nd percentile, as shown in Table 6.6. (values z-0,96 and 0.58 respectively).

The next most important dimension in the table is called *Satisfaction and support* and it has to do with how the teachers perceive the satisfaction of their colleagues regarding the school work, their rapport and success in implementing the school curriculum, and also the support of parents, the respect of the students for the facilities, and their motivation regarding performance. This is a factor that gives us a true image of the educational community and the integration of some of its elements in the realization of a shared task: teachers, parents and students.

Teachers of students with low performances have a significantly worse perception of this dimension, with an average equivalent to the 21st percentile, while teachers of students with high performances have a noticeably better perception, reaching, on average, the 68th percentile.

The third dimension in importance is that of *Professional Satisfaction,* which is directly related to the image that teachers have of themselves, as well as their enthusiasm for the job, the value they give to the importance of the job they do, and their intention of dedicating themselves to this activity for as long as possible. All of this involves the pride in, and valuation of, the task itself. So, teachers of students with worse performance have an average valuation of this dimension that is in the 32nd percentile, while the average of their colleagues who have students with high performance reaches a position equivalent to the 60th percentile.

Naturally, all teachers have students with different performance levels, both high and low, but when we segment the responses according to the performance of students, what happens is that high performance students have, overall, teachers who value themselves more professionally and who are more proud of their job. The opposite happens in the case of teachers of students with low performance. This study does not allow a causal attribution of this data to be made, but it is still interesting and worth carefully considering.

The *Teacher's Interaction with other Teachers* is the next dimension with significant differences. It's a factor which has to do with teamwork, sharing teaching experiences and developing teaching materials (see Table 6.4). With less differences than the previous three dimensions, but in any case significant, the teachers of students with low performance get their mean valuation in this dimension in the 36th percentile, while when we consider students with high performance, the teachers' mean valuation is equivalent to the 60th percentile.

Teaching Limitations is a dimension which is configured around the perceptions of teachers with respect to students with organization problems, special needs, behavioral problems, etc. The differences are also significant but in the opposite direction to the others. This means that teachers of the highest performing students tend to see fewer limitations than for those that have lower performance, which on the other hand, is quite reasonable. The mean values of both groups mean percentiles of 65 (low performance) and 40 (high performance).

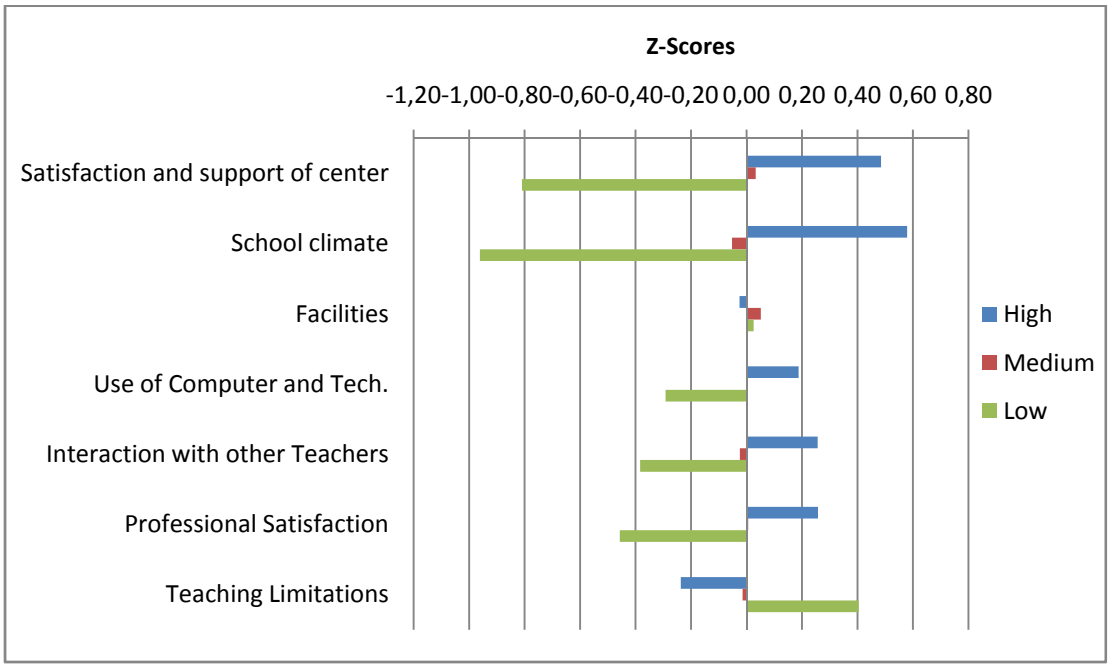
One factor that does not seem to present great difficulties for the teachers is the *Use of computer and technologies* for their work or their integration to the classroom. Despite this the differences are significant, but smaller, in favor of the teachers of students with high performance compared to those with low performance. The mean values are in the 39th percentile (low performance) and 57th percentile (high performance).

Table 6.6. Mean values and significance of the differences between groups of performance for the dimensions calculated from the teacher questionnaire

Dimensions	Performance	N	Mean	Stand. Dev.	Minimum	Maximum	Signif.
Satisfaction and support of center	**Low**	48942	-0,81	1,60	-3,82	3,42	0,000
	Medium	40684	0,03	1,52	-3,82	3,42	
	High	37168	0,48	1,26	-2,96	3,42	
	Total	126794	-0,16	1,58	-3,82	3,42	
School climate	**Low**	48942	-0,96	1,80	-4,80	3,43	0,000
	Medium	40684	-0,05	1,75	-3,91	3,43	
	High	37168	0,58	1,55	-3,68	3,58	
	Total	126794	-0,22	1,83	-4,80	3,58	
Facilities	**Low**	48942	0,03	0,47	-0,94	1,29	0,000
	Medium	40684	0,05	0,49	-0,94	1,18	
	High	37168	-0,03	0,49	-0,94	1,29	
	Total	126794	0,02	0,48	-0,94	1,29	
Use of Computer and Tech.	**Low**	48942	-0,29	0,81	-1,95	2,31	0,000
	Medium	40684	0,00	0,87	-1,95	2,31	
	High	37168	0,19	0,84	-1,95	2,31	
	Total	126794	-0,06	0,86	-1,95	2,31	
Interaction with other Teachers	**Low**	48942	-0,38	1,26	-3,22	3,06	0,000
	Medium	40684	-0,02	1,20	-3,22	3,06	
	High	37168	0,26	1,29	-3,22	3,04	
	Total	126794	-0,08	1,28	-3,22	3,06	
Professional Satisfaction	**Low**	48942	-0,46	0,99	-2,45	1,49	0,000
	Medium	40684	0,01	0,90	-2,45	1,57	
	High	37168	0,26	0,87	-2,45	1,57	
	Total	126794	-0,10	0,98	-2,45	1,57	
Teaching Limitations	**Low**	48942	0,40	0,90	-2,01	2,22	0,000
	Medium	40684	-0,01	0,84	-2,01	2,22	
	High	37168	-0,24	0,72	-2,01	2,04	
	Total	126794	0,08	0,87	-2,01	2,22	

The last dimension to consider is the one called *Facilities for professional development*. It has an inverse direction with respect to the others; in other words, the lower the score the less limitations the teacher perceives regarding the school facilities, materials, number of students, excessive workload, etc. Here, teachers of students with better performance have an mean valuation which is practically equal to that of their colleagues. Both groups are in the 49th and 51st percentile respectively. All of these differences are shown in Figure 6.2.

Figure 6.2. Mean values of the dimensions of the teachers' questionnaire according to students' academic performance



Once the differences of the three groups in the different dimensions have been examined, to finish this study we are going to present and analyze the results of the modeling carried out with Mixed Linear Models.

Table 6.7 shows the results of the model, which includes the twelve constructed dimensions for each one of the performance groups. In this case, the response variable is the individual scores of the students in the five plausible values within each of the defined performance groups. The predictor variables are the previously defined dimensions.

The cut-off point represents the average performance of a student who has a zero value in each of the dimensions that are included as independent factors. Logically, it is observed that the average performance for this student increases in each of the groups configured by their own definition (371, 491 and 592 for groups Low, Medium and High Performance, respectively).

In the low performance group, all the ***students' dimensions*** are significant. This does not happen in the medium performance group, where only the dimensions of *Possessions in the home* (which also has a negative influence) and *Self-confidence* are significant. In the high performance group all the dimensions are significant except those of *Possessions in the home* and *Perception on Math's Class*. It is important to mention that in each dimension the starting level of each group is different, as seen in the variance analysis (Tables 6.5 and 6.6). However, the significance and influence of the dimension becomes significant (or not) within each group.

Table 6.7. MLM estimates by performance group for the calculated dimensions

	Performance								
	Low			Medium			High		
Parameter	**Estimation**	**t**	**Sig.**	**Estimation**	**t**	**Sig.**	**Estimation**	**t**	**Sig.**
Cut-off Point	371,29	3167,87	0,000	490,81	9243,10	0,000	591,93	5279,31	0,000
Possessions	2,94	14,81	0,000	-0,63	-4,10	0,000	0,29	1,29	0,199
Bullying	0,97	7,80	0,000	-0,04	-0,40	0,692	2,00	15,81	0,000
Liking for Maths	4,68	26,55	0,000	0,04	0,34	0,735	-5,10	-27,66	0,000
Perception of Class	-5,58	-20,86	0,000	-0,27	-1,75	0,080	-0,15	-0,65	0,518
Self-confidence	-1,95	-9,92	0,000	1,29	10,08	0,000	9,56	50,70	0,000
Satisfaction and support	3,11	28,51	0,000	-0,28	-4,23	0,000	1,50	13,59	0,000
School climate	0,36	3,73	0,000	0,08	1,25	0,210	-1,52	-14,42	0,000
Facilities	-0,09	-0,37	0,713	-0,50	-3,30	0,001	-0,50	-2,34	0,019
CT	0,80	3,60	0,000	0,13	1,17	0,244	-2,23	-16,76	0,000
Interaction	-2,01	-23,06	0,000	-0,42	-7,70	0,000	0,46	7,34	0,000
Teacher Satisfaction	-1,42	-10,82	0,000	0,15	1,61	0,108	-0,19	-1,50	0,133
Limitations	-3,74	-20,74	0,000	-0,68	-6,94	0,000	-1,28	-8,72	0,000

By doing this analysis in a comparative way between groups, it can be seen that the *Household Possessions in the home* dimension has a large weight (2,94) in the low performance group, while this is not so in the medium level group (which has a small and negative influence) and in the high performance level it is not significant. The *Household Possessions* factor is usually seen as a weak indicator of the socioeconomic level of the family, which is a widely studied factor in the literature on determinants of academic performance. This clearly shows that the influence of *Possessions in the home* is much greater in the low performance group than in the high performance one (where it has no influence), and that in the medium performance group its influence is small and negative.

The *Liking for Math's* dimension has an important and significant weight in the low performance group (4,68). The result of this dimension in the high performance group, where it has a negative effect (-5.10), is paradoxical. It seems that the liking for the subject positively influences the students of the low performance group. The *Perception on Math's class* dimension is only significant in the low performance group, and it has a negative weight (-5,58).

The *Self-confidence* dimension shows a curious evolution in the three groups. It has a negative influence (-1,95) in the low performance group, which means that within this group the students with better performance tend to show lower values in *Self-confidence in Maths*, while the students assigned to this group and to that of low performance have comparatively better

self-confidence, something which may be explained by a very low level of self-demand or perception of their own academic reality. This dimension has a moderate and positive influence on the medium performance group (1,29) and a very great positive influence on the high performance group. In fact, in this latter group it is the dimension which has the greatest influence on performance. This is consistent to the extent that high performance students receive positive feedback about their level of achievement, and according to this their level of self-esteem is more in line with their reality. In this regard, Liu and Meng (2010) examine the factorial structure of attitudinal items and confirm the relationship between results and self-esteem. Along similar lines Yoshino's work (2012) is included, in which there is a comparison between Japanese and American students.

Regarding the **teacher dimensions**, all of them are significant in the low performance group except the *Facilities for professional development*. *Satisfaction and Support in school, Facilities, Interaction with other Teachers and Teaching Limitations* have a significant influence on the medium performance group. In the high performance group it is only the dimensions of *Facilities* and *Professional Satisfaction* that no longer have a significant influence.

In Akyuz and Berberoglu's study (2010) the relationship between the teacher's and classroom's characteristics and the performance in Mathematics is analyzed using the TIMSS data. To do this they developed a multi-level model incorporating these variables with data from 10 countries of the European Union (Turkey, Belgium, Italy, Netherlands, Czech Republic, Lithuania, Slovakia and Cyprus).

In our case, the comparative analysis of the dimensions between groups shows that the *Satisfaction and support in school* dimension has a greater magnitude in the low performance group (3.11). The *School climate* dimension has a small magnitude in all three groups, but in the high performance group it is also negative (-1.52).

The dimension relating to *Facilities* is only significant in the medium performance group, with a small and negative magnitude (-0,5). The *Use of computer and Technology* is significant in the low and high performance groups, but in the latter its weight is moderate and negative (-2,23). For a more in-depth study of these issues, the work of Wang and O'Dwyer (2011) examines the international trends in the use of ICT, and how the student's use of them under the supervision and guidance of the teacher positively influences the results obtained.

The *Interaction with other teachers*, despite being significant in the three groups of performance, only has a positive and small influence on the high performance group (0.46) while it has a relatively high and negative magnitude in the low performance group (-2,01). It is surprising that individual *Professional Satisfaction* is only significant in the low performance group, and with a negative influence (-1,42). The *Teaching Limitations* dimension, logically, has a negative influence on the three groups, but with a much higher magnitude in the low performance group (3,74).

As seen in Table 6.6, the three models shown are significant when comparing the Restricted Likelihood Ratio of the Null Model (model without any predictor) and the Final Model (which

includes the 12 dimensions). The difference between both likelihood ratios follows a χ^2 distribution with 12 degrees of freedom, all with significant values, as can be seen.

Table 6.7. Adjustment of the models by performance group

	Low	Medium	High
Null Model	2486927,55	1855766,92	1789475,23
Final Model	2475859,17	1855259,48	1784828,56
χ^2	11068,375	507,436	4646,665
Significance	0,00000	0,00000	0,00000

CONCLUSIONS AND EDUCATIONAL IMPLICATIONS

It was already mentioned in the introduction to this paper that the context questionnaires are usually the least "strong" part of the International evaluations, and on many occasions the same items that make up these instruments, of a generally weak metric, usually have, by themselves, an explanatory capacity or a rather limited association to the results variables. Therefore, in this study we have carried out a procedure of *dimension* design based on the individual items of the context questionnaire administered to students and teachers, basing our approach on Item Response Theory for polytomic items, specifically the Rasch simple logistic model using the Partial Credit Model (PCM) of Masters (1982). This strategy, adapted to the metric of the items that are answered with a 4-point Likert scale, has proved useful in achieving complex variables, or *latent dimensions,* for both students and teachers, as reflected in Tables 6.3 and 6.4, which have shown a relationship to performance which is substantially greater than the individual items.

The variance analyses carried out using performance as a grouping variable - to check whether the students of low, medium or high performance valued the different dimensions differently (Table 6.4), or whether their teachers had different perceptions about their own (Table 6.5) - have allowed us to verify that all dimensions show significant differences, with the high performance group having the best valuations in the following: *level of possessions in the home, less bullying, greater liking for Maths, more satisfied teachers* and *better classroom climate.* On the other hand, the low performance group show significantly contrasting valuations, as reflected in Figures 6.1 and 6.2.

The strategy of characterization of extreme groups proves to be effective in determining differential effects and particular needs of these groups, which would have not been noticed if the students' scores had been studied all together. Moreover it has been seen that some of the dimensions that show greater differences between extreme groups, such as *Liking for Maths* or *Self-confidence in Maths* in the students case, or the *Satisfaction* perceived by the teachers and *the support* of the different agents involved in the learning process or the school climate, are dimensions that can and must be modified, starting with appropriate education policies and teaching strategies. There are many examples in the literature regarding the

efficacy of certain procedures that can improve the school climate and self-esteem of the pupils as well as students, for example.

In any case, given that the very process of selecting individuals with extreme scores decreases the intragroup variance, these results must always be taken with caution, since the individuals, owing to the procedure are internally homogeneous, and this is how they have been selected. On the other hand, it should be taken into account that both high and low scores are limited and that, by their very construction, the performance scales are designed to measure the center of the distribution, but are less sensitive to its extremes.

Despite all of these limitations, if these tendencies are confirmed, a thorough examination of these differential effects could allow the design of education policies suited to the specific needs and circumstances of the different subgroups, so that the results seem relevant from a practical standpoint.

The linear mixed model, in which the response variable is now performance and the independent variables are the dimensions, as already explained, has allowed us to separately analyze the impact of these dimensions in each of the three performance groups.

The dimensions of the student and the teacher are also segmented into three different sections. Therefore, each performance group incorporates a specific part of the distribution of the different dimensions, i.e.: the high performance group includes the “best” values of these dimensions. This may be the reason for obtaining coefficients that, at first, seem to influence performance in a strange way. For example, the school climate has a negative impact on the high performance group, but the values of that dimension are already high in this group.

In any case, the aim of this study is to characterize each one of the performance groups. And indeed, it can be seen that there are three very different models depending on the group that is studied.

So the model for the low performance group shows that the dimensions with greater impact are *Liking for Maths*, which has a very positive influence; *Perception about Maths class*, which has a very negative influence; *Teaching Limitations* which logically has a negative impact; and *Teacher Satisfaction* and *Support* in the school center.

The medium performance group has few significant dimensions, and even less with a relatively significant weight. We emphasize only the positive impact of *Self-confidence in Maths* and the slight and negative impact of *Possessions in the home*.

The behavior of the high performance group is strongly and positively influenced by *Self-confidence in Maths,* and with a negative estimator for the *Liking for Maths*, perhaps supporting the idea that a student with good performance has so regardless of their liking for the subject. From the area of the teacher we only highlight the negative influence of *Use of Computer and Technologies* on the performance of this group of students.

These results allow us to have a better understanding of the differential effects of certain contextual factors on the student performance, though of course, it is also considered differentially. This line of analysis, in respecting the metric of the variables and incorporating appropriate strategies for the complex sampling structure of these international studies, which makes conventional statistical procedures inadequate, shows an interest that, as we understand, should be implemented more often in this type of studies, given that considering performance in a global way masks clearly diverse realities and education needs.

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APPENDIX

Adjustment of the items and student dimensions

Term 1: ITEM (dichotomous variable)

VARIABLES				UNWEIGHTED FIT			WEIGHTED FIT		
	item	ESTIMATE	ERROR	MNSQ	CI	T	MNSQ	CI	T
2	ASBG05A	-2.913	0.064	0.67	(0.96, 1.04)	-17.1	1.07	(0.85, 1.15)	0.9
3	ASBG05B	-2.525	0.055	0.91	(0.96, 1.04)	-4.0	1.02	(0.88, 1.12)	0.4
4	ASBG05C	-2.824	0.062	0.87	(0.96, 1.04)	-6.0	1.03	(0.86, 1.14)	0.5
5	ASBG05D	-1.529	0.041	1.21	(0.96, 1.04)	8.8	1.03	(0.94, 1.06)	0.9
6	ASBG05E	-1.596	0.041	0.87	(0.96, 1.04)	-6.3	1.06	(0.93, 1.07)	1.8

Term 2: ITEM*STEP (polytomic variable)

VARIABLES					UNWEIGHTED FIT			WEIGHTED FIT		
	item	step	ESTIMATE	ERROR	MNSQ	CI	T	MNSQ	CI	T
1	ASBG04	0			0.91	(0.96, 1.04)	-4.1	1.09	(0.89, 1.11)	1.6
1	ASBG04	1	-1.551	0.039	1.00	(0.96, 1.04)	0.1	1.01	(0.96, 1.04)	0.6
1	ASBG04	2	-0.306	0.033	1.02	(0.96, 1.04)	0.7	1.00	(0.97, 1.03)	0.1
1	ASBG04	3	1.066	0.045	1.09	(0.96, 1.04)	3.8	0.97	(0.92, 1.08)	-0.7
1	ASBG04	4	0.791*		1.55	(0.96, 1.04)	21.4	1.04	(0.91, 1.09)	0.8
7	ASBG09A	0			1.02	(0.96, 1.04)	0.8	0.96	(0.95, 1.05)	-1.6
7	ASBG09A	1	0.141	0.034	0.99	(0.96, 1.04)	-0.2	0.99	(0.94, 1.06)	-0.4
7	ASBG09A	2	0.234	0.046	0.96	(0.96, 1.04)	-1.7	0.97	(0.91, 1.09)	-0.7
7	ASBG09A	3	-0.375*		1.01	(0.96, 1.04)	0.7	1.06	(0.94, 1.06)	1.9
8	ASBG09B	0			0.99	(0.96, 1.04)	-0.4	0.99	(0.95, 1.05)	-0.6
8	ASBG09B	1	0.471	0.036	0.98	(0.96, 1.04)	-1.0	0.97	(0.92, 1.08)	-0.6
8	ASBG09B	2	-0.329	0.047	0.91	(0.96, 1.04)	-4.3	0.96	(0.92, 1.08)	-0.9
8	ASBG09B	3	-0.143*		1.36	(0.96, 1.04)	14.6	1.05	(0.92, 1.08)	1.2
9	ASBG09C	0			0.97	(0.96, 1.04)	-1.4	0.96	(0.96, 1.04)	-1.7
9	ASBG09C	1	0.301	0.035	0.98	(0.96, 1.04)	-0.7	0.98	(0.93, 1.07)	-0.4
9	ASBG09C	2	0.074	0.048	0.90	(0.96, 1.04)	-4.7	0.96	(0.91, 1.09)	-0.8
9	ASBG09C	3	-0.375*		1.02	(0.96, 1.04)	0.8	1.03	(0.93, 1.07)	0.9
10	ASBG09D	0			1.10	(0.96, 1.04)	4.2	1.06	(0.94, 1.06)	2.1
10	ASBG09D	1	0.558	0.041	1.04	(0.96, 1.04)	1.8	0.98	(0.91, 1.09)	-0.4
10	ASBG09D	2	0.012	0.065	1.05	(0.96, 1.04)	2.2	1.00	(0.86, 1.14)	0.1
10	ASBG09D	3	-0.570*		1.87	(0.96, 1.04)	31.4	1.07	(0.88, 1.12)	1.2
11	ASBG09E	0			0.95	(0.96, 1.04)	-2.3	0.98	(0.96, 1.04)	-0.9
11	ASBG09E	1	0.089	0.034	0.95	(0.96, 1.04)	-2.1	0.99	(0.94, 1.06)	-0.2
11	ASBG09E	2	-0.052	0.045	0.90	(0.96, 1.04)	-4.8	0.98	(0.92, 1.08)	-0.5
11	ASBG09E	3	-0.037*		1.04	(0.96, 1.04)	1.8	0.98	(0.92, 1.08)	-0.5
12	ASBG09F	0			0.94	(0.96, 1.04)	-2.9	0.99	(0.95, 1.05)	-0.4
12	ASBG09F	1	0.737	0.040	0.95	(0.96, 1.04)	-2.2	0.97	(0.90, 1.10)	-0.7
12	ASBG09F	2	-0.243	0.059	0.83	(0.96, 1.04)	-8.0	0.98	(0.88, 1.12)	-0.3
12	ASBG09F	3	-0.494*		1.18	(0.96, 1.04)	7.7	1.05	(0.90, 1.10)	1.0
13	ASBM01A	0			0.89	(0.96, 1.04)	-5.0	1.08	(0.88, 1.12)	1.3
13	ASBM01A	1	0.278	0.033	1.01	(0.96, 1.04)	0.6	0.94	(0.90, 1.10)	-1.1
13	ASBM01A	2	-0.091	0.037	1.00	(0.96, 1.04)	0.1	0.97	(0.95, 1.05)	-1.0
13	ASBM01A	3	-0.186*		0.97	(0.96, 1.04)	-1.4	0.97	(0.98, 1.02)	-3.8
14	ASBM01B	0			1.07	(0.96, 1.04)	3.2	1.06	(0.98, 1.02)	6.1
14	ASBM01B	1	0.918	0.036	1.03	(0.96, 1.04)	1.1	0.96	(0.91, 1.09)	-0.8
14	ASBM01B	2	-0.090	0.050	1.04	(0.96, 1.04)	1.7	1.01	(0.89, 1.11)	0.2
14	ASBM01B	3	-0.828*		1.11	(0.96, 1.04)	4.7	1.05	(0.93, 1.07)	1.3
15	ASBM01C	0			1.09	(0.96, 1.04)	4.0	1.08	(0.97, 1.03)	5.5

15	ASBM01C	1	0.830	0.037	1.04	(0.96, 1.04)	1.7	0.96	(0.92, 1.08)	-0.9
15	ASBM01C	2	0.067	0.056	1.05	(0.96, 1.04)	2.3	1.02	(0.87, 1.13)	0.4
15	ASBM01C	3	-0.897*		1.17	(0.96, 1.04)	7.3	1.10	(0.91, 1.09)	2.1
16	ASBM01D	0			0.89	(0.96, 1.04)	-5.2	1.04	(0.83, 1.17)	0.4
16	ASBM01D	1	0.663	0.036	0.93	(0.96, 1.04)	-3.3	0.97	(0.84, 1.16)	-0.4
16	ASBM01D	2	-0.246	0.040	0.98	(0.96, 1.04)	-0.8	0.97	(0.93, 1.07)	-0.8
16	ASBM01D	3	-0.417*		0.94	(0.96, 1.04)	-2.7	0.95	(0.96, 1.04)	-2.4
17	ASBM01E	0			0.94	(0.96, 1.04)	-2.6	1.03	(0.90, 1.10)	0.7
17	ASBM01E	1	0.551	0.034	0.98	(0.96, 1.04)	-1.0	0.97	(0.89, 1.11)	-0.6
17	ASBM01E	2	-0.041	0.039	1.01	(0.96, 1.04)	0.7	0.97	(0.93, 1.07)	-0.9
17	ASBM01E	3	-0.510*		0.96	(0.96, 1.04)	-1.8	0.96	(0.98, 1.02)	-4.1
18	ASBM01F	0			0.78	(0.96, 1.04)	-11.0	1.10	(0.67, 1.33)	0.6
18	ASBM01F	1	1.020	0.044	0.90	(0.96, 1.04)	-4.7	0.95	(0.71, 1.29)	-0.3
18	ASBM01F	2	-0.452	0.047	0.93	(0.96, 1.04)	-3.4	0.99	(0.90, 1.10)	-0.2
18	ASBM01F	3	-0.568*		0.90	(0.96, 1.04)	-4.6	0.97	(0.92, 1.08)	-0.6
19	ASBM02A	0			1.18	(0.96, 1.04)	7.7	1.07	(0.86, 1.14)	1.0
19	ASBM02A	1	0.411	0.035	0.92	(0.96, 1.04)	-3.6	1.00	(0.86, 1.14)	-0.0
19	ASBM02A	2	-0.379	0.037	0.95	(0.96, 1.04)	-2.1	0.99	(0.94, 1.06)	-0.3
19	ASBM02A	3	-0.033*		0.92	(0.96, 1.04)	-3.5	0.95	(0.96, 1.04)	-2.8
20	ASBM02B	0			1.30	(0.96, 1.04)	12.2	1.23	(0.97, 1.03)	12.5
20	ASBM02B	1	0.171	0.033	1.02	(0.96, 1.04)	0.8	0.98	(0.94, 1.06)	-0.7
20	ASBM02B	2	0.092	0.044	1.25	(0.96, 1.04)	10.3	1.01	(0.92, 1.08)	0.4
20	ASBM02B	3	-0.263*		3.04	(0.96, 1.04)	60.5	1.12	(0.93, 1.07)	3.2
21	ASBM02C	0			1.51	(0.96, 1.04)	19.8	1.06	(0.82, 1.18)	0.7
21	ASBM02C	1	0.111	0.035	0.85	(0.96, 1.04)	-6.9	1.06	(0.87, 1.13)	0.9
21	ASBM02C	2	-0.066	0.039	0.93	(0.96, 1.04)	-3.3	0.99	(0.94, 1.06)	-0.3
21	ASBM02C	3	-0.046*		0.89	(0.96, 1.04)	-5.1	0.95	(0.96, 1.04)	-2.4
22	ASBM02D	0			0.93	(0.96, 1.04)	-3.4	1.04	(0.77, 1.23)	0.4
22	ASBM02D	1	0.270	0.037	0.81	(0.96, 1.04)	-9.3	0.96	(0.83, 1.17)	-0.4
22	ASBM02D	2	-0.305	0.039	0.91	(0.96, 1.04)	-4.0	0.97	(0.93, 1.07)	-1.0
22	ASBM02D	3	0.035*		0.86	(0.96, 1.04)	-6.8	0.90	(0.95, 1.05)	-4.1
23	ASBM02E	0			0.99	(0.96, 1.04)	-0.6	1.02	(0.82, 1.18)	0.3
23	ASBM02E	1	0.048	0.035	0.83	(0.96, 1.04)	-8.0	0.96	(0.87, 1.13)	-0.6
23	ASBM02E	2	-0.086	0.038	0.96	(0.96, 1.04)	-1.8	0.97	(0.94, 1.06)	-1.1
23	ASBM02E	3	0.038*		0.88	(0.96, 1.04)	-5.4	0.90	(0.96, 1.04)	-5.3
24	ASBM03A	0			0.95	(0.96, 1.04)	-2.2	1.14	(0.81, 1.19)	1.4
24	ASBM03A	1	-0.029	0.033	1.00	(0.96, 1.04)	-0.0	0.97	(0.89, 1.11)	-0.6
24	ASBM03A	2	0.084	0.037	0.99	(0.96, 1.04)	-0.3	0.99	(0.94, 1.06)	-0.4
24	ASBM03A	3	-0.054*		0.98	(0.96, 1.04)	-1.1	0.98	(0.98, 1.02)	-1.2
25	ASBM03B	0			1.04	(0.96, 1.04)	1.9	1.03	(0.98, 1.02)	3.6
25	ASBM03B	1	0.561	0.033	1.02	(0.96, 1.04)	1.0	0.96	(0.93, 1.07)	-1.1
25	ASBM03B	2	-0.077	0.045	1.03	(0.96, 1.04)	1.2	1.00	(0.91, 1.09)	-0.0
25	ASBM03B	3	-0.484*		0.97	(0.96, 1.04)	-1.3	1.03	(0.92, 1.08)	0.9
26	ASBM03C	0			1.05	(0.96, 1.04)	2.0	1.04	(0.98, 1.02)	4.1
26	ASBM03C	1	0.574	0.034	1.02	(0.96, 1.04)	0.9	0.99	(0.93, 1.07)	-0.3
26	ASBM03C	2	0.002	0.049	1.01	(0.96, 1.04)	0.5	1.01	(0.89, 1.11)	0.1
26	ASBM03C	3	-0.576*		1.01	(0.96, 1.04)	0.6	1.06	(0.91, 1.09)	1.2
27	ASBM03D	0			0.87	(0.96, 1.04)	-6.2	1.09	(0.86, 1.14)	1.3
27	ASBM03D	1	-0.141	0.032	0.94	(0.96, 1.04)	-2.9	1.00	(0.92, 1.08)	-0.0
27	ASBM03D	2	0.118	0.036	1.02	(0.96, 1.04)	0.7	0.97	(0.95, 1.05)	-1.2
27	ASBM03D	3	0.023*		0.97	(0.96, 1.04)	-1.5	0.97	(0.98, 1.02)	-4.4
28	ASBM03E	0			0.98	(0.96, 1.04)	-1.1	1.03	(0.92, 1.08)	0.9
28	ASBM03E	1	-0.167	0.032	0.98	(0.96, 1.04)	-0.8	0.98	(0.95, 1.05)	-0.9
28	ASBM03E	2	0.111	0.036	1.00	(0.96, 1.04)	-0.1	1.00	(0.95, 1.05)	-0.1
28	ASBM03E	3	0.056*		0.98	(0.96, 1.04)	-1.0	0.97	(0.96, 1.04)	-1.9

29	ASBM03F	0			0.96	(0.96, 1.04)	-1.9	1.03	(0.90, 1.10)	0.6
29	ASBM03F	1	-0.105	0.032	0.98	(0.96, 1.04)	-0.7	0.97	(0.93, 1.07)	-1.0
29	ASBM03F	2	0.012	0.035	1.01	(0.96, 1.04)	0.3	0.99	(0.96, 1.04)	-0.3
29	ASBM03F	3	0.093*		0.96	(0.96, 1.04)	-1.9	0.98	(0.98, 1.02)	-1.9
30	ASBM03G	0			1.05	(0.96, 1.04)	2.4	1.05	(0.98, 1.02)	5.2
30	ASBM03G	1	0.724	0.035	1.01	(0.96, 1.04)	0.5	0.98	(0.92, 1.08)	-0.6
30	ASBM03G	2	0.074	0.049	1.01	(0.96, 1.04)	0.3	1.02	(0.89, 1.11)	0.4
30	ASBM03G	3	-0.798*		1.03	(0.96, 1.04)	1.4	1.04	(0.93, 1.07)	1.2
31	ASBS04A	0			0.98	(0.96, 1.04)	-1.0	0.94	(0.87, 1.13)	-0.9
31	ASBS04A	1	0.458	0.034	0.97	(0.96, 1.04)	-1.4	0.92	(0.88, 1.12)	-1.3
31	ASBS04A	2	-0.228	0.037	0.98	(0.96, 1.04)	-0.7	0.98	(0.94, 1.06)	-0.7
31	ASBS04A	3	-0.229*		0.93	(0.96, 1.04)	-3.4	0.92	(0.97, 1.03)	-6.5
32	ASBS04B	0			1.18	(0.96, 1.04)	7.7	1.14	(0.98, 1.02)	10.7
32	ASBS04B	1	0.728	0.035	1.03	(0.96, 1.04)	1.3	0.96	(0.92, 1.08)	-0.9
32	ASBS04B	2	0.133	0.052	1.11	(0.96, 1.04)	4.9	1.03	(0.88, 1.12)	0.5
32	ASBS04B	3	-0.861*		1.52	(0.96, 1.04)	20.3	1.06	(0.93, 1.07)	1.8
33	ASBS04C	0			1.01	(0.96, 1.04)	0.4	0.98	(0.95, 1.05)	-0.9
33	ASBS04C	1	0.109	0.032	0.97	(0.96, 1.04)	-1.2	0.98	(0.94, 1.06)	-0.8
33	ASBS04C	2	0.195	0.040	0.99	(0.96, 1.04)	-0.3	0.99	(0.93, 1.07)	-0.3
33	ASBS04C	3	-0.304*		0.90	(0.96, 1.04)	-4.6	0.97	(0.96, 1.04)	-1.5
34	ASBS04D	0			1.20	(0.96, 1.04)	8.4	1.13	(0.97, 1.03)	8.4
34	ASBS04D	1	0.678	0.036	1.03	(0.96, 1.04)	1.3	0.99	(0.92, 1.08)	-0.4
34	ASBS04D	2	0.163	0.056	1.15	(0.96, 1.04)	6.5	1.00	(0.87, 1.13)	0.0
34	ASBS04D	3	-0.842*		1.84	(0.96, 1.04)	30.2	1.07	(0.91, 1.09)	1.4
35	ASBS04E	0			0.86	(0.96, 1.04)	-6.7	1.00	(0.83, 1.17)	0.0
35	ASBS04E	1	0.614	0.037	0.87	(0.96, 1.04)	-6.2	0.97	(0.84, 1.16)	-0.4
35	ASBS04E	2	-0.138	0.042	0.96	(0.96, 1.04)	-2.0	0.97	(0.92, 1.08)	-0.8
35	ASBS04E	3	-0.476*		0.89	(0.96, 1.04)	-5.2	0.91	(0.96, 1.04)	-4.1
36	ASBS04F	0			0.98	(0.96, 1.04)	-1.1	0.97	(0.89, 1.11)	-0.5
36	ASBS04F	1	0.449	0.034	0.95	(0.96, 1.04)	-2.2	0.97	(0.89, 1.11)	-0.6
36	ASBS04F	2	-0.124	0.038	1.00	(0.96, 1.04)	0.1	0.96	(0.94, 1.06)	-1.1
36	ASBS04F	3	-0.325*		0.93	(0.96, 1.04)	-3.1	0.92	(0.98, 1.02)	-6.5
37	ASBS04G	0			0.74	(0.96, 1.04)	-13.1	1.03	(0.74, 1.26)	0.2
37	ASBS04G	1	0.757	0.040	0.82	(0.96, 1.04)	-8.7	1.04	(0.78, 1.22)	0.4
37	ASBS04G	2	-0.381	0.043	0.93	(0.96, 1.04)	-3.4	0.97	(0.92, 1.08)	-0.6
37	ASBS04G	3	-0.376*		0.88	(0.96, 1.04)	-5.6	0.94	(0.94, 1.06)	-1.9
38	ASBS05A	0			1.17	(0.96, 1.04)	7.1	1.09	(0.88, 1.12)	1.5
38	ASBS05A	1	0.351	0.035	0.90	(0.96, 1.04)	-4.9	0.97	(0.88, 1.12)	-0.4
38	ASBS05A	2	-0.278	0.038	0.96	(0.96, 1.04)	-1.9	1.00	(0.94, 1.06)	-0.1
38	ASBS05A	3	-0.073*		0.92	(0.96, 1.04)	-3.8	0.94	(0.96, 1.04)	-3.2
39	ASBS05B	0			1.39	(0.96, 1.04)	15.6	1.28	(0.96, 1.04)	13.9
39	ASBS05B	1	0.265	0.033	1.04	(0.96, 1.04)	1.9	0.97	(0.94, 1.06)	-0.8
39	ASBS05B	2	0.100	0.046	1.31	(0.96, 1.04)	12.9	1.02	(0.91, 1.09)	0.4
39	ASBS05B	3	-0.364*		3.76	(0.96, 1.04)	74.7	1.11	(0.93, 1.07)	3.2
40	ASBS05C	0			1.06	(0.96, 1.04)	2.5	0.97	(0.84, 1.16)	-0.3
40	ASBS05C	1	0.169	0.036	0.89	(0.96, 1.04)	-5.3	0.99	(0.87, 1.13)	-0.1
40	ASBS05C	2	-0.041	0.040	0.95	(0.96, 1.04)	-2.2	0.98	(0.93, 1.07)	-0.5
40	ASBS05C	3	-0.128*		0.89	(0.96, 1.04)	-5.2	0.92	(0.95, 1.05)	-3.7
41	ASBS05D	0			0.78	(0.96, 1.04)	-10.6	1.00	(0.79, 1.21)	0.0
41	ASBS05D	1	0.280	0.038	0.87	(0.96, 1.04)	-6.2	0.91	(0.83, 1.17)	-1.1
41	ASBS05D	2	-0.210	0.041	0.90	(0.96, 1.04)	-4.8	0.97	(0.93, 1.07)	-0.8
41	ASBS05D	3	-0.070*		0.84	(0.96, 1.04)	-7.8	0.89	(0.95, 1.05)	-4.4
42	ASBS05E	0			1.02	(0.96, 1.04)	0.8	1.04	(0.84, 1.16)	0.6
42	ASBS05E	1	0.129	0.036	0.84	(0.96, 1.04)	-7.8	0.90	(0.87, 1.13)	-1.5
42	ASBS05E	2	-0.037	0.040	0.95	(0.96, 1.04)	-2.4	0.96	(0.93, 1.07)	-1.3

42	ASBS05E	3	-0.092*		0.86	(0.96, 1.04)	-6.5	0.87	(0.96, 1.04)	-5.8
43	ASBS06A	0			0.94	(0.96, 1.04)	-2.7	1.10	(0.85, 1.15)	1.3
43	ASBS06A	1	0.210	0.033	0.97	(0.96, 1.04)	-1.3	0.96	(0.89, 1.11)	-0.6
43	ASBS06A	2	-0.198	0.036	1.00	(0.96, 1.04)	-0.1	0.98	(0.95, 1.05)	-0.7
43	ASBS06A	3	-0.011*		0.97	(0.96, 1.04)	-1.5	0.96	(0.98, 1.02)	-3.2
44	ASBS06B	0			1.07	(0.96, 1.04)	2.9	1.06	(0.98, 1.02)	5.9
44	ASBS06B	1	0.440	0.033	1.01	(0.96, 1.04)	0.7	0.97	(0.93, 1.07)	-0.9
44	ASBS06B	2	-0.034	0.045	1.01	(0.96, 1.04)	0.3	1.03	(0.91, 1.09)	0.7
44	ASBS06B	3	-0.407*		1.07	(0.96, 1.04)	3.2	1.02	(0.92, 1.08)	0.5
45	ASBS06C	0			1.07	(0.96, 1.04)	3.0	1.07	(0.98, 1.02)	6.2
45	ASBS06C	1	0.554	0.035	1.01	(0.96, 1.04)	0.4	0.99	(0.93, 1.07)	-0.3
45	ASBS06C	2	-0.010	0.049	1.03	(0.96, 1.04)	1.2	1.02	(0.90, 1.10)	0.4
45	ASBS06C	3	-0.543*		1.11	(0.96, 1.04)	4.8	1.03	(0.91, 1.09)	0.6
46	ASBS06D	0			0.85	(0.96, 1.04)	-7.3	1.05	(0.87, 1.13)	0.7
46	ASBS06D	1	-0.141	0.032	0.97	(0.96, 1.04)	-1.2	1.00	(0.92, 1.08)	-0.1
46	ASBS06D	2	0.057	0.035	1.00	(0.96, 1.04)	-0.1	0.98	(0.95, 1.05)	-0.7
46	ASBS06D	3	0.084*		0.96	(0.96, 1.04)	-1.9	0.96	(0.98, 1.02)	-3.9
47	ASBS06E	0			0.89	(0.96, 1.04)	-5.0	0.99	(0.92, 1.08)	-0.1
47	ASBS06E	1	-0.004	0.032	1.00	(0.96, 1.04)	0.2	0.97	(0.93, 1.07)	-0.7
47	ASBS06E	2	-0.027	0.036	1.00	(0.96, 1.04)	0.1	0.99	(0.95, 1.05)	-0.6
47	ASBS06E	3	0.031*		0.96	(0.96, 1.04)	-2.0	0.97	(0.97, 1.03)	-1.9
48	ASBS06F	0			1.08	(0.96, 1.04)	3.5	1.08	(0.98, 1.02)	6.6
48	ASBS06F	1	0.638	0.034	1.02	(0.96, 1.04)	1.0	0.97	(0.92, 1.08)	-0.9
48	ASBS06F	2	0.018	0.047	1.04	(0.96, 1.04)	2.0	1.01	(0.90, 1.10)	0.2
48	ASBS06F	3	-0.656*		1.12	(0.96, 1.04)	5.2	1.04	(0.93, 1.07)	1.0

Adjustment indices of the items and teacher dimensions

Term 2: ITEM*STEP (polytomous variables)

VARIABLES					UNWEIGHTED FIT			WEIGHTED FIT		
	item	step	ESTIMATE	ERROR	MNSQ	CI	T	MNSQ	CI	T
1	ATBG06A	1			2.62	(0.80, 1.20)	11.0	0.88	(0.00, 2.34)	0.0
1	ATBG06A	2	-3.826	0.232	1.03	(0.80, 1.20)	0.3	1.08	(0.72, 1.28)	0.6
1	ATBG06A	3	-0.064	0.163	1.11	(0.80, 1.20)	1.1	1.09	(0.80, 1.20)	0.9
1	ATBG06A	4	3.890*		0.80	(0.80, 1.20)	-2.1	1.06	(0.56, 1.44)	0.3
2	ATBG06B	2			1.69	(0.80, 1.20)	5.6	1.23	(0.60, 1.40)	1.1
2	ATBG06B	3	-2.033	0.163	1.06	(0.80, 1.20)	0.6	1.11	(0.81, 1.19)	1.1
2	ATBG06B	4	2.033*		14.80	(0.80, 1.20)	42.3	1.20	(0.69, 1.31)	1.3
3	ATBG06C	1			0.39	(0.80, 1.20)	-7.8	0.98	(0.07, 1.93)	0.1
3	ATBG06C	2	-3.822	0.259	0.72	(0.80, 1.20)	-3.0	0.99	(0.77, 1.23)	-0.0
3	ATBG06C	3	-0.127	0.167	1.00	(0.80, 1.20)	0.0	1.00	(0.80, 1.20)	-0.0
3	ATBG06C	4	3.949*		0.66	(0.80, 1.20)	-3.7	0.87	(0.39, 1.61)	-0.3
4	ATBG06D	0			0.02	(0.80, 1.20)	-21.1	0.88	(0.00, 2.70)	0.1
4	ATBG06D	1	-3.299	0.314	0.12	(0.80, 1.20)	-14.5	0.87	(0.21, 1.79)	-0.2
4	ATBG06D	2	-2.799	0.263	0.78	(0.80, 1.20)	-2.3	0.95	(0.81, 1.19)	-0.5
4	ATBG06D	3	1.304	0.168	0.92	(0.80, 1.20)	-0.7	1.01	(0.82, 1.18)	0.1
4	ATBG06D	4	4.794*		0.40	(0.80, 1.20)	-7.5	0.96	(0.29, 1.71)	0.0
5	ATBG06E	0			0.47	(0.80, 1.20)	-6.5	1.08	(0.29, 1.71)	0.3
5	ATBG06E	1	-3.271	0.299	0.75	(0.80, 1.20)	-2.6	1.04	(0.65, 1.35)	0.3
5	ATBG06E	2	-1.881	0.212	0.98	(0.80, 1.20)	-0.1	0.99	(0.85, 1.15)	-0.1
5	ATBG06E	3	1.074	0.179	1.27	(0.80, 1.20)	2.4	1.03	(0.79, 1.21)	0.3
5	ATBG06E	4	4.078*		0.49	(0.80, 1.20)	-6.1	1.25	(0.15, 1.85)	0.7
6	ATBG06F	0			0.31	(0.80, 1.20)	-9.3	0.86	(0.34, 1.66)	-0.4
6	ATBG06F	1	-3.267	0.281	2.09	(0.80, 1.20)	8.1	0.97	(0.69, 1.31)	-0.1
6	ATBG06F	2	-1.716	0.199	1.01	(0.80, 1.20)	0.1	1.01	(0.85, 1.15)	0.2
6	ATBG06F	3	1.380	0.190	0.83	(0.80, 1.20)	-1.7	1.03	(0.76, 1.24)	0.3
6	ATBG06F	4	3.603*		1.41	(0.80, 1.20)	3.6	1.67	(0.19, 1.81)	1.5
7	ATBG06G	1			0.27	(0.80, 1.20)	-10.2	0.78	(0.28, 1.72)	-0.5
7	ATBG06G	2	-3.432	0.240	1.25	(0.80, 1.20)	2.3	1.06	(0.79, 1.21)	0.6
7	ATBG06G	3	-0.226	0.165	1.09	(0.80, 1.20)	0.9	1.16	(0.81, 1.19)	1.6
7	ATBG06G	4	3.658*		0.52	(0.80, 1.20)	-5.7	1.31	(0.42, 1.58)	1.1
8	ATBG06H	0			0.12	(0.80, 1.20)	-14.6	1.32	(0.00, 2.66)	0.6
8	ATBG06H	1	-3.205	0.278	0.24	(0.80, 1.20)	-11.0	1.17	(0.26, 1.74)	0.5
8	ATBG06H	2	-2.555	0.238	0.87	(0.80, 1.20)	-1.3	1.05	(0.81, 1.19)	0.6
8	ATBG06H	3	1.270	0.164	0.98	(0.80, 1.20)	-0.2	0.95	(0.83, 1.17)	-0.5
8	ATBG06H	4	4.490*		1.15	(0.80, 1.20)	1.4	0.97	(0.42, 1.58)	-0.0
9	ATBG07A	0			0.24	(0.80, 1.20)	-10.9	0.92	(0.16, 1.84)	-0.1
9	ATBG07A	1	-0.574	0.171	1.70	(0.80, 1.20)	5.7	1.34	(0.30, 1.70)	1.0
9	ATBG07A	2	-0.957	0.168	0.90	(0.80, 1.20)	-1.0	1.00	(0.84, 1.16)	-0.0
9	ATBG07A	3	1.531*		0.84	(0.80, 1.20)	-1.6	1.03	(0.79, 1.21)	0.3
10	ATBG07B	1			0.28	(0.80, 1.20)	-10.1	0.83	(0.13, 1.87)	-0.3
10	ATBG07B	2	-1.074	0.191	0.74	(0.80, 1.20)	-2.7	0.90	(0.74, 1.26)	-0.7
10	ATBG07B	3	1.074*		0.71	(0.80, 1.20)	-3.1	0.89	(0.72, 1.28)	-0.7
11	ATBG07C	0			0.01	(0.80, 1.20)	-21.9	0.53	(0.00, 2.43)	-0.5
11	ATBG07C	1	-2.251	0.178	0.88	(0.80, 1.20)	-1.1	1.07	(0.51, 1.49)	0.4
11	ATBG07C	2	0.096	0.167	0.97	(0.80, 1.20)	-0.3	0.95	(0.84, 1.16)	-0.6
11	ATBG07C	3	2.155*		0.99	(0.80, 1.20)	-0.1	1.05	(0.79, 1.21)	0.5
12	ATBG07D	0			0.87	(0.80, 1.20)	-1.3	2.03	(0.15, 1.85)	2.0
12	ATBG07D	1	-1.542	0.180	0.86	(0.80, 1.20)	-1.4	1.09	(0.49, 1.51)	0.4
12	ATBG07D	2	-1.266	0.161	0.90	(0.80, 1.20)	-1.0	1.01	(0.81, 1.19)	0.1

12	ATBG07D	3	2.808*		0.71	(0.80, 1.20)	-3.1	0.96	(0.71, 1.29)	-0.3
13	ATBG07E	0			2.41	(0.80, 1.20)	10.0	1.25	(0.05, 1.95)	0.6
13	ATBG07E	1	-0.329	0.153	1.36	(0.80, 1.20)	3.2	1.18	(0.40, 1.60)	0.6
13	ATBG07E	2	-1.124	0.147	1.05	(0.80, 1.20)	0.5	1.06	(0.94, 1.06)	2.0
13	ATBG07E	3	1.453*		1.29	(0.80, 1.20)	2.6	1.27	(0.82, 1.18)	2.8
14	ATBG08A	0			1.00	(0.80, 1.20)	0.0	1.03	(0.83, 1.17)	0.3
14	ATBG08A	1	-0.537	0.151	1.06	(0.80, 1.20)	0.6	0.94	(0.81, 1.19)	-0.6
14	ATBG08A	2	-0.363	0.172	0.94	(0.80, 1.20)	-0.5	1.20	(0.76, 1.24)	1.6
14	ATBG08A	3	0.900*		0.71	(0.80, 1.20)	-3.1	0.91	(0.42, 1.58)	-0.2
15	ATBG08B	0			0.98	(0.80, 1.20)	-0.2	1.01	(0.85, 1.15)	0.2
15	ATBG08B	1	-0.193	0.150	1.12	(0.80, 1.20)	1.2	0.91	(0.75, 1.25)	-0.7
15	ATBG08B	2	-0.538	0.182	1.01	(0.80, 1.20)	0.2	0.89	(0.72, 1.28)	-0.7
15	ATBG08B	3	0.731*		1.17	(0.80, 1.20)	1.6	0.87	(0.37, 1.63)	-0.3
16	ATBG08C	0			0.84	(0.80, 1.20)	-1.7	0.96	(0.84, 1.16)	-0.5
16	ATBG08C	1	-0.678	0.150	1.07	(0.80, 1.20)	0.7	0.95	(0.84, 1.16)	-0.7
16	ATBG08C	2	-0.216	0.181	1.02	(0.80, 1.20)	0.3	0.86	(0.72, 1.28)	-1.0
16	ATBG08C	3	0.895*		0.65	(0.80, 1.20)	-3.9	0.98	(0.31, 1.69)	0.1
17	ATBG08D	0			0.86	(0.80, 1.20)	-1.4	0.93	(0.85, 1.15)	-0.9
17	ATBG08D	1	-0.449	0.149	0.97	(0.80, 1.20)	-0.3	1.05	(0.81, 1.19)	0.5
17	ATBG08D	2	-0.255	0.186	0.91	(0.80, 1.20)	-0.8	0.91	(0.70, 1.30)	-0.6
17	ATBG08D	3	0.704*		0.68	(0.80, 1.20)	-3.4	0.97	(0.36, 1.64)	0.0
18	ATBG08E	0			0.87	(0.80, 1.20)	-1.3	0.87	(0.87, 1.13)	-2.0
18	ATBG08E	1	-1.401	0.153	0.98	(0.80, 1.20)	-0.2	0.97	(0.85, 1.15)	-0.3
18	ATBG08E	2	-0.786	0.201	0.80	(0.80, 1.20)	-2.1	0.87	(0.65, 1.35)	-0.8
18	ATBG08E	3	2.187*		1.05	(0.80, 1.20)	0.5	0.47	(0.00, 3.62)	-0.1
19	ATBG09BA	1			1.09	(0.72, 1.28)	0.7	0.96	(0.44, 1.56)	-0.1
19	ATBG09BA	2	-0.520	0.200	1.01	(0.72, 1.28)	0.1	1.01	(0.90, 1.10)	0.3
19	ATBG09BA	3	0.520*		0.99	(0.72, 1.28)	-0.1	1.02	(0.89, 1.11)	0.3
20	ATBG09BB	0			1.14	(0.72, 1.28)	1.0	1.06	(0.80, 1.20)	0.6
20	ATBG09BB	1	-0.169	0.197	1.04	(0.72, 1.28)	0.3	0.99	(0.72, 1.28)	-0.1
20	ATBG09BB	2	-0.272	0.228	1.11	(0.72, 1.28)	0.8	1.02	(0.68, 1.32)	0.2
20	ATBG09BB	3	0.440*		0.80	(0.72, 1.28)	-1.5	1.23	(0.35, 1.65)	0.7
21	ATBG09BC	0			0.91	(0.72, 1.28)	-0.6	1.06	(0.32, 1.68)	0.3
21	ATBG09BC	1	-0.139	0.197	0.89	(0.72, 1.28)	-0.7	1.15	(0.54, 1.46)	0.7
21	ATBG09BC	2	-0.231	0.206	1.01	(0.72, 1.28)	0.1	0.97	(0.81, 1.19)	-0.3
21	ATBG09BC	3	0.370*		1.00	(0.72, 1.28)	0.0	1.01	(0.82, 1.18)	0.2
22	ATBG10A	0			1.51	(0.80, 1.20)	4.4	1.16	(0.61, 1.39)	0.8
22	ATBG10A	1	-2.053	0.173	0.92	(0.80, 1.20)	-0.8	0.92	(0.84, 1.16)	-1.0
22	ATBG10A	2	0.028	0.163	0.92	(0.80, 1.20)	-0.8	0.99	(0.84, 1.16)	-0.1
22	ATBG10A	3	2.025*		1.86	(0.80, 1.20)	6.8	1.03	(0.63, 1.37)	0.2
23	ATBG10B	0			0.53	(0.80, 1.20)	-5.6	0.92	(0.54, 1.46)	-0.3
23	ATBG10B	1	-2.567	0.189	0.77	(0.80, 1.20)	-2.4	0.88	(0.85, 1.15)	-1.6
23	ATBG10B	2	0.150	0.163	0.90	(0.80, 1.20)	-0.9	0.90	(0.84, 1.16)	-1.3
23	ATBG10B	3	2.418*		0.91	(0.80, 1.20)	-0.8	1.10	(0.56, 1.44)	0.5
24	ATBG10C	0			0.54	(0.80, 1.20)	-5.4	0.99	(0.63, 1.37)	-0.0
24	ATBG10C	1	-1.908	0.165	0.88	(0.80, 1.20)	-1.2	0.99	(0.85, 1.15)	-0.1
24	ATBG10C	2	0.515	0.175	0.85	(0.80, 1.20)	-1.5	0.88	(0.79, 1.21)	-1.2
24	ATBG10C	3	1.394*		0.86	(0.80, 1.20)	-1.4	1.05	(0.67, 1.33)	0.3
25	ATBG10D	0			1.68	(0.80, 1.20)	5.6	1.34	(0.69, 1.31)	2.0
25	ATBG10D	1	-0.610	0.191	1.47	(0.80, 1.20)	4.0	1.17	(0.66, 1.34)	1.0
25	ATBG10D	2	-0.401	0.281	0.93	(0.80, 1.20)	-0.7	0.90	(0.54, 1.46)	-0.4
25	ATBG10D	3	1.011*		3.42	(0.80, 1.20)	14.8	1.93	(0.05, 1.95)	1.7
26	ATBG10E	0			1.64	(0.80, 1.20)	5.3	1.22	(0.67, 1.33)	1.3

26	ATBG10E	1	-2.242	0.177	0.92	(0.80, 1.20)	-0.8	1.01	(0.87, 1.13)	0.1
26	ATBG10E	2	0.188	0.177	0.83	(0.80, 1.20)	-1.7	0.95	(0.80, 1.20)	-0.5
26	ATBG10E	3	2.054*		0.52	(0.80, 1.20)	-5.6	0.86	(0.50, 1.50)	-0.5
27	ATBG11A	0			0.58	(0.80, 1.20)	-4.8	0.29	(0.00, 4.96)	0.2
27	ATBG11A	1	-1.206	0.179	0.55	(0.80, 1.20)	-5.3	1.15	(0.17, 1.83)	0.5
27	ATBG11A	2	0.586	0.192	0.95	(0.80, 1.20)	-0.4	0.82	(0.66, 1.34)	-1.0
27	ATBG11A	3	0.620*		0.86	(0.80, 1.20)	-1.4	0.82	(0.74, 1.26)	-1.4
28	ATBG11B	0			0.45	(0.80, 1.20)	-6.9	1.01	(0.00, 2.36)	0.2
28	ATBG11B	1	-0.358	0.164	0.63	(0.80, 1.20)	-4.1	1.05	(0.38, 1.62)	0.3
28	ATBG11B	2	0.156	0.178	0.92	(0.80, 1.20)	-0.8	0.97	(0.72, 1.28)	-0.2
28	ATBG11B	3	0.202*		0.84	(0.80, 1.20)	-1.6	0.91	(0.82, 1.18)	-1.0
29	ATBG11C	0			1.35	(0.80, 1.20)	3.1	1.25	(0.88, 1.12)	3.7
29	ATBG11C	1	0.304	0.154	1.01	(0.80, 1.20)	0.1	1.06	(0.70, 1.30)	0.4
29	ATBG11C	2	-0.182	0.204	1.40	(0.80, 1.20)	3.5	1.11	(0.61, 1.39)	0.6
29	ATBG11C	3	-0.122*		3.00	(0.80, 1.20)	12.9	1.00	(0.55, 1.45)	0.1
30	ATBG11D	1			0.92	(0.80, 1.20)	-0.8	0.42	(0.00, 3.57)	-0.1
30	ATBG11D	2	-1.284	0.178	1.01	(0.80, 1.20)	0.1	0.93	(0.74, 1.26)	-0.5
30	ATBG11D	3	1.284*		1.00	(0.80, 1.20)	0.1	0.93	(0.74, 1.26)	-0.5
31	ATBG11E	0			0.96	(0.80, 1.20)	-0.4	0.82	(0.10, 1.90)	-0.3
31	ATBG11E	1	1.086	0.169	1.03	(0.80, 1.20)	0.3	0.94	(0.00, 2.12)	0.1
31	ATBG11E	2	-1.127	0.174	0.94	(0.80, 1.20)	-0.5	0.91	(0.75, 1.25)	-0.7
31	ATBG11E	3	0.042*		0.92	(0.80, 1.20)	-0.7	0.87	(0.81, 1.19)	-1.3
32	ATBG11F	1			0.77	(0.80, 1.20)	-2.4	0.90	(0.14, 1.86)	-0.1
32	ATBG11F	2	0.224	0.212	0.93	(0.80, 1.20)	-0.7	0.84	(0.59, 1.41)	-0.7
32	ATBG11F	3	-0.224*		0.87	(0.80, 1.20)	-1.3	0.80	(0.68, 1.32)	-1.3
33	ATBG16A	0			1.58	(0.80, 1.20)	4.8	1.12	(0.41, 1.59)	0.4
33	ATBG16A	1	-1.266	0.181	0.93	(0.80, 1.20)	-0.6	1.12	(0.68, 1.32)	0.8
33	ATBG16A	2	-1.049	0.154	0.95	(0.80, 1.20)	-0.5	1.06	(0.85, 1.15)	0.9
33	ATBG16A	3	2.315*		0.71	(0.80, 1.20)	-3.2	1.02	(0.58, 1.42)	0.1
34	ASBS04D	0			1.25	(0.80, 1.20)	2.3	1.17	(0.81, 1.19)	1.7
34	ASBS04D	1	-1.310	0.164	1.12	(0.80, 1.20)	1.1	1.11	(0.82, 1.18)	1.2
34	ASBS04D	2	-0.167	0.259	1.06	(0.80, 1.20)	0.6	1.15	(0.50, 1.50)	0.6
34	ASBS04D	3	1.477*		0.58	(0.80, 1.20)	-4.9	1.12	(0.00, 2.36)	0.4
35	ASBS04E	0			2.77	(0.80, 1.20)	11.8	1.07	(0.77, 1.23)	0.6
35	ASBS04E	1	-1.647	0.175	0.94	(0.80, 1.20)	-0.6	1.01	(0.79, 1.21)	0.1
35	ASBS04E	2	-1.615	0.172	0.98	(0.80, 1.20)	-0.2	1.02	(0.80, 1.20)	0.2
35	ASBS04E	3	3.262*		0.57	(0.80, 1.20)	-4.9	0.77	(0.00, 2.90)	0.1
36	ASBS04F	0			1.00	(0.80, 1.20)	0.0	1.14	(0.65, 1.35)	0.8
36	ASBS04F	1	-0.727	0.169	0.97	(0.80, 1.20)	-0.2	0.82	(0.65, 1.35)	-1.0
36	ASBS04F	2	-1.406	0.156	1.07	(0.80, 1.20)	0.7	1.09	(0.85, 1.15)	1.2
36	ASBS04F	3	2.132*		0.68	(0.80, 1.20)	-3.5	1.49	(0.50, 1.50)	1.7
37	ASBS04G	0			0.96	(0.80, 1.20)	-0.4	1.10	(0.71, 1.29)	0.7
37	ASBS04G	1	-0.775	0.157	0.90	(0.80, 1.20)	-0.9	0.92	(0.75, 1.25)	-0.6
37	ASBS04G	2	-0.652	0.158	1.11	(0.80, 1.20)	1.0	0.98	(0.87, 1.13)	-0.3
37	ASBS04G	3	1.427*		0.70	(0.80, 1.20)	-3.2	1.09	(0.61, 1.39)	0.5
38	ASBS05A	0			0.75	(0.80, 1.20)	-2.6	0.86	(0.09, 1.91)	-0.2
38	ASBS05A	1	-1.379	0.180	0.75	(0.80, 1.20)	-2.7	1.03	(0.60, 1.40)	0.2
38	ASBS05A	2	-1.011	0.154	0.99	(0.80, 1.20)	-0.1	1.04	(0.85, 1.15)	0.6
38	ASBS05A	3	2.390*		0.65	(0.80, 1.20)	-3.9	1.01	(0.68, 1.32)	0.1


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