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EVOLUTION OF THE SCHOOL FAILURE RISK DURING THE 2000 DECADE IN SPAIN: ANALYSIS OF PISA RESULTS WITH A TWO-LEVEL LOGISTIC MODEL[*]

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ABSTRACT: School failure has been one of the principal problems of the Spanish educational system during recent decades. This paper offers a perspective of the evolution of the factors that have had a significant influence over the risk of school failure considering personal, household and school characteristics through multilevel logistic regression analyses of PISA 2000, 2003, 2006 and 2009 microdata.

JEL Codes: I2, H52, C25

Keywords: School failure, multilevel logistic regression, PISA, compulsory education

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1. Introduction

Overcoming high rates of school failure is one of the most complex challenges faced by Spanish society. National and international studies, such as Fernández Enguita et al. (2010), and OECD reports (2010, 2011), address the problem of the low performance of Spanish students compared to their European peers. Results are clear: Spain faces higher levels of school failure and early school dropout.

The broad definition of school failure includes all forms of not achieving the educational objectives determined by society as the minimum necessary to be integrated into the labor market and to become a productive member of the community. Accordingly, the definition of school failure chosen in this paper includes all the individuals who are not able to complete compulsory secondary education (ESO) at the age of 16.

School failure in Spain appears to have structural characteristics, as it has been present in the educational system for more than 30 years, with figures fluctuating around 30% during the last two decades. The failure to accomplish the objective proposed by the Lisbon Strategy in 2010, and the difficulty of achieving the Europe 2020 strategy of reducing the early school leaver rate in EU countries to less than 10%, is an indicator of the difficulty of addressing the causes of the problem.

The aim of this paper is to analyze the evolution of the factors that determined the school failure risk during the 2000 decade in Spain. In this paper, following the work of authors such as Schleicher (2007), school failure risk is defined as the probability of obtain a score below level-2 in reading competence in the Programme for International Student Assessment (PISA). The selection of reading competence as the main area in this analysis is due to the emphasis that this competence has in two of the four PISA tests (2000 and 2009).

The analysis is performed using 2000, 2003, 2006 and 2009 PISA micro-data for Spain. This should allow the observation of variations in the determinants over time, and their importance as predictors of school failure risk, widening the scope of previous works such as Calero et al. (2010) or Choi and Calero (in press) and permitting the introduction of methodological improvements.

Table 1 compares the real school failure rates in Spain and the risk of school failure in the competences for all the PISA tests. The measure of the school failure risk in PISA tends to underestimate the real volume of students who fail.

Table 1
Risk of school failure by competences in the Spain PISA tests

	2000	2003	2006	2009
School failure (real)	26.6	28.7	30.8	25.9
Reading competence	16.7	18.5	19.1	20.0
Mathematics competence	25.0	20.4	17.2	21.8
Scientific knowledge competentence	20.6	20.3	14.0	17.7

Source: OECD-PISA 2000, 2003, 2006 and 2009 databases and Ministerio de Educación, Cultura y Deporte (2011).

This paper is structured as follows: Section 2 explains and justifies the individual, household and school-level variables considered in the analysis. Section 3 presents the data and the methodology, while Section 4 discusses the results. Finally the main conclusions are presented in the last section.

2. Determinants of academic performance and school failure

The present section has been divided into three sub-sections, in accordance with the three blocks of explicative variables considered in this paper: Personal, family and school characteristics.

2.1 Personal characteristics

The differences in the academic performance of students depend on a number of characteristics that are distinctive at an individual level, and have a direct influence on the probability of school success. Gender appears to be an important personal determinant that affects the academic performance of students. There is a significant difference in the ESO graduation rates between males and females. Using year 2006-2007 data, Fernández

Enguita (2010) found a variation of almost 14 percentage points for females over males in graduation rates.

A capacity for organization, discipline and attention appears to be a more common characteristic of female students, who also seem to have an advantage in the learning processes. It is therefore to be expected that a positive relation will be found between obtaining a high score in the PISA reading test and being female. It is also anticipated, that a lower proportion of female students will be at risk of school failure compared with their male peers. It is important to mention that this result does not hold for the PISA math test (Calero and Choi, 2010).

Table 2 shows the proportion of students who obtain a low result in the PISA reading competence in the four PISA evaluations.

Table 2

Probabilities of obtaining a grade under level-2 on the PISA reading test according to personal characteristics.

Personal Variables	2000	2003	2006	2009
Grade				
2^0 ESO	74.19%	68.06%	69.35%	66.96%
3^0 ESO	42.05%	39.32%	38.37%	35.78%
4^0 ESO	5.46%	9.68%	7.90%	7.38%
Gender				
Male	20.81%	24.90%	25.14%	24.19%
Female	10.94%	11.83%	13.00%	13.89%
Birth month				
January to March	14.68%	17.59%	16.47%	16.87%
October to December	19.13%	21.17%	22.01%	20.43%
Country of birth				
Spain	15.34%	17.39%	17.81%	16.98%
Others	29.95%	34.34%	36.82%	35.65%
Origin of the student				
National students	16.31%	17.85%	18.22%	18.43%
First generation immigrants	33.33%	40.27%	40.86%	38.23%
Second generation immigrants		29.54%	32.99%	35.45%
Aggregate mean	17.37%	19.95%	20.44%	19.98%

Source: Own compilation with OECD-PISA 2000, 2003, 2006 and 2009 databases.

Another characteristic linked to the degree of maturity of the pupils is the month of birth of the student. Crawford et al. (2011) found evidence that students born between January and March seem to obtain consistently better grades than students who were born from October to December. A variable that accounts for the month of birth is introduced to test the difference in the possible outcomes of the students in the PISA tests.

Not all the students in the sample were born in Spain. An increasing proportion of students among the four PISA waves used in this article have diverse nationalities and origins. Being an immigrant is an important characteristic that seems to increase the risk of school failure (Table 2) and is related with adaptation issues, such as language and cultural differences (McCarthy, 1998).

2.2 Household characteristics

Household attributes and material resources are two important aspects to be considered in the analysis of academic performance. The Coleman Report (1966) provided evidence that family background is the main factor in student academic performance.

Hanushek (1997) showed that differences in household environments, like students living in single-parent families and students coming from lower socio-economical backgrounds, are relevant for individual academic achievement. Haveman and Wolfe (1995) affirm that the household's background characteristics have the greatest effect on the academic achievement of the students.

There is an important difference in the academic performance of students whose parents belong to a managerial or professional category compared to those from families where the parents are manual workers (Cohen, 1987). The former represent a small segment of the population and have a significant advantage in school achievement, grades and completion rates compared to the latter. Consequently, the model presented in Section 3 includes a variable that describes the highest socio-economic category of the households.

There is ample literature that shows the relationship between the educational level of the parents and the performance of the students. Ferguson et al. (1996) posited that parental

education accounted for about 24 percent of the variance in student's test scores; Reynolds and Temple (1998) affirm that the level of education of the parents is positively associated with test scores and negatively with grade retention. Consequently, it is expected that an inverse relation will be observed between the level of education attained by parents and the probability of the students being at risk of school failure.

Table 3 illustrates the percentage of students at risk of school failure according to the evaluation results in the PISA reading competences and considering family attributes.

Table3

Probability of obtaining a grade under level-2 on the PISA reading test considering household characteristics.

Household Variables	2000	2003	2006	2009
Occupation of the parents				
Working	15.59%	16.77%	15.86%	15.32%
Not working	19.12%	22.03%	24.15%	22.37%
Socio-economical category				
Skilled white-collar worker	2.91%	6.54%	8.36%	6.37%
Unskilled white-collar worker	8.03%	11.15%	11.87%	9.56%
Blue-collar worker	19.11%	20.78%	22.31%	22.05%
Parental education level				
Tertiary education	8.59%	10.51%	12.43%	10.84%
Compulsory secondary education (ESO)	11.17%	16.87%	16.74%	18.43%
Primary education	24.91%	25.42%	34.89%	30.47%
Did not finish primary education	45.26%	40.95%	46.33%	55.51%
Home educational resources				
Computer, calculator, books and dictionary	12.23%	14.80%	14.06%	13.56%
Does not have these resources	22.53%	27.01%	23.63%	22.04%
Household cultural possessions				
Literature, poetry and works of art	10.71%	12.37%	13.88%	13.37%
Does not have these possessions	27.37%	26.50%	29.05%	29.55%
Aggregate mean	17.37%	19.95%	20.44%	19.98%

Source: Own compilation with OECD-PISA 2000, 2003, 2006 and 2009 databases.

The possession of cultural resources is expected to have a negative relation to the risk of school failure (Berger et al., 2005). In the same way, the possession of a large number of books is correlated with early reading competence in individuals (Aikens and Barbarin,

2008). Two variables that account for the household's cultural environment and the specific material possessions within the household are incorporated in the model, and it is predicted they will reduce the probability of obtaining a score below level-2 in the PISA reading test.

2.3. School characteristics

The school-level determinants refer to the characteristics of the schools, the type of students who enroll in them and their material resources and their allocation. The most relevant factors affecting the risk of school failure seem to be to a significant extent already set before the students enter school, but it is important to determine if the school magnifies or reduces the differences between students with diverse characteristics and risk factors.

One significant determinant associated with the characteristics of the educational institutions is school ownership. State schools concentrate a larger proportion of immigrant students and students with a greater diversity of characteristics and family backgrounds. The rate of graduation from ESO in private schools is almost 20 percent over the rate in public institutions (Ministerio de Educación, 2009).

Interaction between students sharing certain characteristics contributes to the enhancement or the reduction of the academic performance of their peers (Coleman et al., 1966). In accordance to this idea, the following determinants are introduced: the proportion of females in the school population, the proportion of immigrant students, the socio-economic characteristics of the students and also the educational level attained by the parents.

Table 4 shows the rate of students who could not achieve results equal to or above level-2 in the PISA reading competences, considering school attributes.

Table 4

Probability of obtaining a grade under level-2 on the PISA reading test considering school characteristics.

School Variables	2000	2003	2006	2009
Size of the community where schools are located				
Community +100.000 inhabitants	12.63%	17.18%	15.29%	13.55%
Community +1.000.000 inhabitants	10.64%	18.02%	17.45%	18.14%
Type of school				
Private government independent	4.68%	11.13%	10.14%	8.13%
Private government dependent	10.32%	13.02%	13.69%	11.69%
Public	21.06%	22.93%	23.74%	23.97%
School size (number of students)				
Over the average	13.93%	12.44%	14.29%	17.00%
Under the average	19.63%	20.29%	22.22%	20.66%
Percentage of girls				
Over the average	17.23%	17.27%	18.39%	18.61%
Under the average	14.39%	17.57%	19.86%	19.78%
Ratio students-computers				
Over the average	17.88%	22.34%	22.60%	21.28%
Under the average	14.76%	14.68%	16.91%	17.33%
Ratio students-teacher				
Over the average	8.91%	10.65%	13.81%	12.71%
Under the average	20.54%	22.93%	23.25%	23.00%
Ratio immigrants-national				
Immigrant students over 20%	33.33%	38.14%	30.89%	26.34%
Immigrant students over 30%	28.81%	53.42%	40.00%	30.05%
Educational school environment				
Tertiary education	7.19%	8.93%	10.07%	10.65%
Compulsory secondary education (ESO)	14.12%	19.23%	19.84%	22.59%
Primary education	26.16%	32.07%	30.64%	58.59%
Socio-professional school environment				
Skilled white-collar parents	0.00%	0.00%	3.50%	1.96%
Unskilled white-collar parents	4.51%	6.50%	8.86%	7.13%
Blue-collar parents	18.32%	20.69%	20.79%	20.45%
Budget management autonomy				
School resposibility	16.22%	11.33%	15.18%	9.76%
Not a school resposibility	25.00%	21.04%	22.63%	19.96%
Course content autonomy				
School resposibility	15.89%	17.83%	19.40%	17.57%
Not a school resposibility	17.72%	18.11%	18.60%	19.35%
Aggregate mean	17.37%	19.95%	20.44%	19.98%

Source: Own compilation with OECD-PISA 2000, 2003, 2006 and 2009 databases.

Calero and Escardibul (2007), using PISA-2003, found that there is no significant difference in the performance of the students at different types of schools in Spain, and Cordero et al. (2011) reach the same conclusion, demonstrating that this variable was not relevant in the academic achievement of the students tested in PISA-2009. Considering this empirical evidence, it is expected it will be found that differences in the ownership of the school are not relevant determinants of school failure risk if socio-economical characteristics are being controlled for.

The controversial debate over the importance of a reduced teacher-student ratio in the classroom is also considered in the analysis. While authors such as Krueger (2002) argued for the need to reduce class sizes in order to improve the quality of education, Hanushek (2003) and Chingos (2010) consider the student-teacher ratio to be a factor that does not enhance the quality of education or academic results. To test this, we include a variable that represents the student-teacher ratio.

Even when the real effect of school material resources on the academic performance of the students is a matter of debate due to the results of international (Hanushek, 2003) and national studies (Calero, Choi and Waisgrais, 2010), variables such as the school size and the students-per-computer ratio have been included with the purpose of observing their evolution throughout the 2000 decade. However, as Lavy (2012) warns, resource analysis may not be adequate if endogeneity is not addressed, that is, if the fact that schools with certain profiles have higher student-teacher ratios than others. This is clearly a research area to be explored in Spain in the future.

Finally, another group of variables included in the analysis covers the participation of schools in the school budgetary allocation and the course contents. According to the results observed by Calero and Waisgrais (2009), the effect of these variables is not particularly significant. However, considering the use of data from different years, it could still be possible to observe interesting results regarding the effect of the autonomy of schools on school failure risk.

3. Data and methodology

This section is divided into two parts. The first part describes the data provided by the PISA evaluations, the mechanism employed to gather the data; and the strategy necessary to handle this particular kind of database. The second part of the section outlines the econometric technique and model best suited to fit the PISA databases.

3.1. Data

The database for this paper corresponds to the OECD Programme for International Student Assessment (PISA) implemented in the late nineties as a strategy for the periodic international evaluation of the general competence of 15 year-old students. The sample in the present work covers the four PISA evaluations completed during the 2000 decade.

Table 5 describes the size of the sample of students and schools considered for each one of the four PISA evaluations in the present analysis.

Table 5
Sample size and target population of the Spain PISA tests from 2000 to 2009

	2000	2003	2006	2009
Total population of 15 years old	451.685	454.064	439.415	433.224
Students sample	6.214	10.791	19.604	25.887
Weighted student participants	399.055	344.372	381.686	387.054
Schools sample	185	383	686	889

Source: OECD-PISA 2000, 2003, 2006 and 2009 databases.

In each PISA evaluation, emphasis is placed on one specific competence. These competences were reading in the 2000 test, mathematics in 2003, scientific knowledge in 2006 and again reading in 2009.

The PISA test consists of three survey forms, one for the students, one for the parents and one for the head of the school. In Spain the parent questionnaire was omitted and,

consequently, the main sources of information were the students and the schools. The student's questionnaire is designed to gather information about specific competences and also background information regarding the personal and household characteristics of the students. The school questionnaire collects information from the schools and makes it possible to match information between students and schools.

The sampling design is carried out in two stages. In the first stage, a sample of schools is randomly selected from a list of eligible schools. In the second stage a subsample of 35 students of 15 years old is randomly selected within each school. Student and school level sampling weights are provided to correct marginal deviation from the random probability process of selection.

The educational outputs of the PISA evaluation are the scores in the standardized tests that give different values to the capabilities of the students. Non-observable random factors which can affect the test result are controlled through a set of plausible values. This characteristic of the PISA tests implies the need to incorporate the plausible values for each competence in the analysis.

Missing values, present in all the PISA evaluations, require a particular approach that allows the true nature of the data to be left unaffected. The methodology that seems most appropriate is the Multiple Imputation strategy (Rubin, 1987), a procedure by which missing data are imputed several times to produce different complete data estimates of the parameters. The estimated parameters are combined to produce an overall estimate of the complete data parameters with minimal effects on the standard error.

3.2. Methodology

The analysis of PISA data requires multilevel modeling in order to account for the hierarchical structure of the data and a logit-type specification for the binary response dependent variable. We use a two-level formulation proposed by Raudenbush and Bryk (2002), the first level corresponds to data from the students clustered within schools, and the second level captures the influence of the school factors.

Traditional techniques are not suited to accounting for the hierarchical and clustered structure of the data. Multilevel regression takes into account the nested distribution of the data within larger units of concentration, calculating a different equation for each level of aggregation. These models not only identify the relations of different variables within the same level but also the influence of variables from one level to another.

Two level random-intercept fixed-slope logistic regression model

Level 1 model

1) $\eta_{ij} = \beta_{0j} + \sum_{k=1}^{n} \beta_{1j} X_{kij} + \xi_{ij}$

2) $p_{ij} = \frac{exp(\eta_{ij})}{1 + exp(\eta_{ij})}$

$y_{ij} = 1 \; with \; probability \; p_{ij}$

$y_{ij} = 0 \; with \; probability \; 1 - p_{ij}$

3) $\log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \beta_{0j} + \sum_{k=1}^{n} \beta_{1j} X_{kij} + \xi_{ij}$

Level 2 model

4) $\beta_{0j} = \gamma_{00} + \sum_{1} \gamma_{01} Z_{lj} + u_{0j}$

5) $\beta_{1j} = \gamma_{10}$

$u_{0j} \sim N(0, \tau_{00})$

Full model

6) $\log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \gamma_{00} + \gamma_{10} X_{kij} + \gamma_{01} Z_{lj} + u_{0j} X_{kij} + u_{0j} + \xi_{ij}$

In the equations x_{kij} represents the student level covariates and Z_{lj} school level covariates. $\beta_{0j}..\beta_{1j}$ represent regression coefficients. $u_{0j} \sim N(0, \tau_{00})$ are school specific random intercepts, uncorrelated across schools and uncorrelated with covariates. $\xi_{ij} \sim$ logistic are student-specific residuals, uncorrelated across students and schools, uncorrelated with u_{0j} and with covariates.

4. Results

The regression results are shown in Table 6. Annex A describes the variance reduction analysis. The interpretation of the odd-ratios depends on the specification of the variables and the sign of the coefficients. When the variable has a positive coefficient, every 0.1 over 1.0 represents a 10% increase in the probability that the student scores below level-2 in the reading competence. On the contrary, if the coefficient is negative, every 0.1 under 1 represents a 10% decrease in the probability of obtaining a grade under level-2.

In two particular cases, variables were replaced due to the differences in the sample size and the information available in the database for the four PISA evaluations. The immigration variable used in the 2000 and 2003 regressions (COB) was replaced by two variables (FGIM and SGIM) in 2006 and 2009, with the purpose of illustrating in more detail the evolution of the immigrant students in the school system in Spain. The chosen thresholds for the ratio of immigrant students/total students at school was, for the 2000 and 2003 analyses, 20% (IRATIO20) and, for 2006 and 2009, 30% (IRATIO30).

Two mechanisms were used complementarily to check the correlations between independent variables with a correlation matrix and also to test the variance inflation factors (VIFs)[2]. Level 1 and level 2 variables were inspected separately.

Table 6 shows the coefficients of the two-level logistic regressions, the signs of which reflect the relation between the explanatory variables (personal, household and school characteristics) and the dependent variable (probability of obtaining a score below level-2

[2] We consider that if any of the VIF values is larger than 4 there are multicollinearity problems associated with the variable.

in reading competence), and the odd-ratios or likelihood ratios and the robust standard errors.

Table 6

Multilevel logistic regressions fixed effects. Estimation for the probability of obtaining a score below level-2 in the reading competence PISA evaluations.

	2000 HLM Coeff.	2000 HLM Odd Ratio	2003 HLM Coeff.	2003 HLM Odd Ratio	2006 HLM Coeff.	2006 HLM Odd Ratio	2009 HLM Coeff.	2009 HLM Odd Ratio
CONSTANT	-1.611 ***	0.2	-1.547 ***	0.2	-1.244 ***	0.3	-1.494 ***	0.2
	(0.448)		(0.445)		(0.298)		(0.290)	
SEX (gender)	0.724 ***	2.1	0.844 ***	2.3	0.710 ***	2.0	0.720 ***	2.1
	(0.103)		(0.083)		(0.062)		(0.060)	
M_BIRTH1(born in the 1st quarter)	-0.107	0.9	-0.045	1.0	-0.222 ***	0.8	-0.137 *	0.9
	(0.131)		(0.093)		(0.081)		(0.067)	
M_BIRTH3(born in the 4th quarter)	0.262 **	1.3	0.072	1.1	0.160 *	1.2	0.162 *	1.2
	(0.111)		(0.092)		(0.075)		(0.068)	
SEC1(skilled white-collar worker)	0.263	1.3	-0.075	0.9	0.006	1.0	0.010	1.0
	(0.289)		(0.231)		(0.173)		(0.162)	
SEC2(non-skilled white-collar)	-0.260	0.8	-0.226	0.8	-0.332 ***	0.7	-0.374 ***	0.7
	(0.176)		(0.129)		(0.100)		(0.097)	
COB (country of birth)	-0.368	0.7	-0.301	0.7				
	(0.235)		(0.215)					
FGIM (1st generation immigrant)					0.938 ***	2.6	0.961 ***	2.6
					(0.148)		(0.100)	
SGIM (2nd generation immigrant)					-0.086	0.9	0.304	1.4
					(0.336)		(0.274)	
OCCP (occupation of the parents)	0.201 *	1.2	-0.030	1.0	-0.394 ***	0.7	-0.096	0.9
	(0.091)		(0.084)		(0.078)		(0.062)	
HELP (Highest education level parents)	-0.073 ***	0.9	-0.029 *	1.0	-0.048 ***	1.0	-0.045 ***	1.0
	(0.014)		(0.015)		(0.011)		(0.011)	
HEDR (Home educational resources)	-0.464 ***	0.6	-0.423 ***	0.7	-0.387 ***	0.7	-0.381 ***	0.7
	(0.094)		(0.084)		(0.069)		(0.073)	
CULT (Cultural possessions/family)	-0.599 ***	0.6	-0.458 ***	0.6	-0.558 ***	0.6	-0.572 ***	1.0
	'(0.101)		(0.085)		(0.076)		(0.063)	
ST1 (Community +100.000 inhabit.)	0.001	1.0	0.155	1.2	-0.019	1.0	-0.105	0.9
	(0.170)		(0.175)		(0.133)		(0.148)	
ST2 (Community +1.000.000 inhab.)	-0.117	0.9	-0.255	0.8	-0.436 **	0.6	-0.535 **	0.6
	(0.244)		(0.288)		(0.214)		(0.232)	
TOS1 (Type of school: Private)	-0.393	0.7	-0.114	0.9	-0.252	0.8	0.059	1.1
	(0.380)		(0.367)		(0.277)		(0.385)	
TOS2 (T.of S. Private Government dependent)	-0.334	0.7	-0.147	0.9	-0.334 **	0.7	-0.147	0.9
	(0.289)		(0.257)		(0.175)		(0.277)	
SCHLSIZE (Size of school by students)	-0.051	1.0	-0.267	0.8	-0.091	0.9	0.035	1.0
	(0.191)		(0.198)		(0.124)		(0.132)	
PCGIRLS (girls/school ratio)	-0.088	0.9	-0.231 **	0.8	0.009	1.0	-0.059	0.9
	(0.167)		(0.138)		(0.118)		(0.106)	
RATCOMP (student/computer ratio)	-0.216	0.8	0.276	1.3	-0.046	1.0	0.131	1.1
	(0.156)		(0.204)		(0.113)		(0.118)	
STRATIO (student/teacher ratio)	-0.157	0.9	-0.121	0.9	-0.063	0.9	-0.221	0.8
	(0.286)		(0.305)		(0.168)		(0.241)	
IRATIO20 (Immigrant +20% population)	0.894 ***	2.5	0.917 ***	2.5				
	(0.308)		(0.320)					
IRATIO30 (Immigrant +30% population)					0.371 *	1.5	0.108	1.1
					(0.189)		(0.166)	
CLM3 (Most parents have tertiary education – school environment)	-0.306	0.7	-0.383	0.7	-0.248	0.8	-0.283 *	0.8
	(0.231)		(0.244)		(0.173)		(0.145)	
SPLP3 (Most parents are blue-collar category – school environment)	0.894 ***	2.5	0.574 *	1.8	0.629 ***	1.9	0.377	1.5
	(0.293)		(0.284)		(0.256)		(0.264)	
B_MNGMENT (School budget autonomy)	-0.614 *	0.5	-0.065	0.9	-0.163	0.8	-0.411 *	0.7
	(0.336)		(0.305)		(0.132)		(0.222)	
								0.9
C_CONTENT (School curricular content autonomy)	-0.049	1.0	-0.072	0.9	0.074	1.1	-0.080	
	(0.182)		(0.157)		(0.123)		(0.164)	
Observations	6,214		10,791		19,604		25,887	
Number of schools	185		383		686		889	
				***	**	*		
				p<0.01,	p<0.05,	p<0.1		

Note 1: *** p<0.01, ** p<0.05,* p<0.1, Standard errors in parentheses.

Note 2: The base category is constructed around these characteristics: Personal variables: Being female; being born between April and September; being born outside Spain. Household variables: Family whose parents belong to the blue-collar socio-professional category; parents not economically active; the household does not own educational resources and cultural possessions. School variables:

Community has less than 100.000 inhabitants; state school; size of school by number of students, under or equal the average; percentage of girls in the school, under or equal the average; student-computer ratio, under or equal the average; student-teacher ratio, under or equal the average; immigrant students ratio, under or equal 20% of the population; academic environment of the schools consisting of parents who have attained primary and secondary level of education; the socio-professional environment of the schools, consisting of parents who belong to the white-collar skilled and non-skilled categories; school without autonomy in budget management and course content.

4.1 Personal variables

The first variable with an important statistical significance in the regressions for the four years is the gender of the student. Being male increases one's chance of obtaining a result under level-2 in reading competence by over 100%. This result is consistent in all the regressions: 110% in 2000, 130% in 2003, 100% in 2006 and 110% in 2009.

This result implies that for every female student who obtains an unsatisfactory result in reading competence, there are at least two males in the same situation. The uniformity of the results over time seems to support the conclusions of Bertrand and Pan (2011) that showed the higher rates of success of females in the school system.

As suggested by Crawford et al. (2011), the month of birth seems to have an important relation to academic achievement and the cognitive skills of the students. The negative sign of the coefficient for the variable for students who were born from January to March, suggests that students born in the first quarter of the year are less likely to obtain a deficient result in the reading competence of the PISA evaluation. The same pattern is observed for the variable that describes the students born in the last quarter of the year, but with the opposite sign, indicating that students born from October to December are more prone to fail to obtain a result over level-2 in reading competence.

Regarding the origin of the students, a single variable that represents students who were born in Spain and whose parents are not from outside Spain was introduced for the 2000 and 2003 PISA evaluations. Not being an immigrant reduced the probability of being at risk of failure on the reading competence by 30%, compared with first and second generation immigrant students.

For 2006 and 2009, two variables were incorporated. The first variable corresponds to first generation immigrants and, as was anticipated, this variable was statistically significant for both years. The odd-ratios suggest that students born outside Spain and whose parents are

first generation immigrants, had a 160% higher risk of obtaining poor results in the reading test in both 2006 and 2009, compared to their peers born in Spain.

The second variable corresponds to second generation immigrant students, those born in Spain but whose parents are both from outside Spain. The regression indicates that the variable is statistically non significant for 2006 and 2009. These results suggest that second generation immigrant students do not perform differently to students born in Spain whose parents are also born within the country. Second generation immigrants obtain remarkably superior results in the reading tests compared to first generation immigrant students.

4.2 Household variables

The variables describing family characteristics are divided into two categories. The first, attempts to characterize the family within a specific socio-economic and professional group, considering the educational achievement of the parents. The second group of variables considers the underlying relationship between achievement at school and the educational material and cultural resources of the household.

4.2.1 Socio-economic composition and educational level of the household.

The first variable in this category refers to parents with the highest socio-professional level: skilled white-collar workers. The results for this variable are statistically non-significant, so the odd-ratios results do not indicate a better performance by the students whose parents belong to this group in particular. However, students whose parents belong to the non-skilled white-collar socio professional category, seem to have a consistently lower probability of obtaining low results in the four years evaluated: 20% less during 2000 and 2003, and 30% less during 2006 and 2009, compared to the base category of blue-collar workers. It is important to notice that these results are very significant for the 2006 and 2009 years.

The general tendency seems to be that when both parents work, there is a slight reduction in the possibility of obtaining a score under level-2 on the reading competence, the 2000

regression being an exception, as its positive coefficient suggests the opposite relation. The effect seems to be consistent through time, but it is not possible to obtain a conclusive result.

Highest educational achievement by the parents has the effect of decreasing the risk of obtaining an unsatisfactory result in reading competence. The continuous variable indicates that the higher the level of education of the parents the lower the probability of being at risk. It is important to mention that although statistically significant, the odd-ratios do not indicate an important reduction in the probability of obtaining a result below level-2 in the test, probably showing that the impact of parental education operates indirectly through other variables.

4.2.2. Cultural and educational resources of the household

The first variable in this category (HEDR) is an index provided by PISA that measures the possession of home educational resources. Results in Table 6 show that the possession of these resources is statistically very significant and decreased the probability of obtaining a low result in reading competence by 40% in 2000, and by 30% during the 2003, 2006 and 2009 regressions.

The variable that incorporates the effect of cultural possessions within the family, CULT, gathers three elements: Wheter the household owns classical literature, books of poetry and works of art[3]. The results of the regressions for this variable suggest that the presence of cultural elements in the home significantly reduces the risk of obtaining a result under level-2 in the reading competence by 40% for 2000, 2003 and 2006. However in 2009 cultural possessions seemingly had less of an effect on performance in comparison with that observed for the previous years.

[3] Further explanation on the construction of HEDR and CULT can be found in OECD (Technical Report PISA2000; p.225); OECD (Technical Report PISA2003; p.283); OECD (Technical Report PISA2006; p. 316) and OECD (Resultados del informe PISA2009 - Aprendiendo a Aprender V, p.112).

4.3 School variables

School variables are divided into five categories: types of schools and their location, school inputs, school composition, environment of the schools and autonomy of the school.

4.3.1 School characteristics

The first two variables in this category are related to the size of the town/city where the school is located. They intend to capture whether the concentration of population has an effect on the results of the students that belong to schools in a certain area.

Schools located in municipalities with populations of over a million inhabitants present a remarkable result. The signs of the coefficients are stable and negative during the four years considered, but the effect of the variable, as the evolution of the coefficients suggests, appears to increase over time (Table 6), indicating that students from schools located in metropolitan zones have an increasingly lower probability of being at risk.

Within this category, a second group of variables considered are those that describe the schools by the type of ownership.

Accordingly to the results obtained by Calero and Waisgrais (2009), the ownership of the school appears to have a neutral effect on the probability of obtaining a deficient result on the reading competence under level-2, with the sole exception of the students enrolled in private publicly-funded schools in 2006, where the risk of school failure was reduced by 30% compared to students attending state schools.

The last variable contemplated in this category, SCHLSIZE, describes the size of the school in terms of the number of students. As can be seen in Table 6, the proportion of students who perform poorly in reading competence appears to be large in schools where the number of students is under the average. However the lack of statistical significance underlines the neutral effect of the variable on the risk of school failure.

4.3.2. School resources

In this category two variables have been taken into consideration. The first measures the student-computer ratio. The second is the student-teacher ratio, identified by the STRATIO variable. Both variables are statistically non-significant in all the regressions. Overall, results in this category are consistent with those obtained by Calero, Choi and Waisgrais (2010).

4.3.3. School composition

Three variables are considered in this category. The first describes the percentage of girls in the school population. The regression results indicate a positive impact on the reduction of the probability of school failure risk when the percentage of girls in the student population is over the average, but the estimates are only statistically significantly in 2003.

A ratio of immigrant students over 20% of the student population (IRATIO 20) is statistically significant for both the 2000 and 2003 regressions (Table 6). The positive sign of the regression indicates that students in schools that include more than 20% of immigrant students had a higher risk (150%) of obtaining a result under level-2 in reading competence in 2000 and 2003.

In 2006 and 2009 the variable IRATIO20 was replaced by IRATIO30. This variable was introduced because exploratory regressions using the IRATIO20 variable showed that the results were not statistically significant for these two years. With the introduction of IRATIO30, the significance threshold of the variable was increased. This variable only considered schools that had a rate of immigrant students over 30% of the total size of the school population. The results show that this variable appears to be slightly significant only in 2006.

4.3.4. The school environment

Schools with a concentration of parents with ISCED 5 and 6 educational levels are compared to the rest of the schools. The results of the regressions pointed out, as expected, that schools with a larger proportion of parents with tertiary education have a student population that appears to have a lower risk of obtaining a result below level-2 in the reading competence compared to schools where the educational achievement of the parents is lower.

The second and last variable in this category, SPLP3, indicates schools in which a majority of families belong to the blue-collar socio-professional category. The regression coefficients are positive and statistically significant in 2000, 2003 and 2006. The odd-ratios corroborate the idea that schools where there are more families whose parents are blue-collar workers are characterized by students that appear to have a greater probability of obtaining a poor result in the reading test evaluation. Students in this group of schools were 150% more at risk in 2000, 80% in 2003, 90% in 2006 and 50% in 2009. As can be observed, the tendency seems to be decreasing over time.

4.3.5. School autonomy

Two variables measure the degree of autonomy of the school in this category. The variable B_MNGMNT describes the level of school budgetary autonomy. The results of the regression are statistically significant in 2000 and 2009, but only at a level of 10%, suggesting that a high degree of independence in the allocation of resources does not have an important effect on the risk of students obtaining low results in reading competence compared to schools with less autonomy.

The C_CONTENT variable denotes schools with a significant degree of autonomy in the selection of curriculum content. The lack of statistical significance implies that the variable has a neutral effect over the probability of obtaining a result under level-2 in reading competence. The regression outcomes for both school autonomy variables does not offer a conclusive result and further research is suggested for the future.

5. Conclusions

The most interesting contribution of this paper to the previous literature on school failure risk is the possibility of observing the evolution over a whole decade of a group of factors that appear to have an important impact on the academic performance of students in Spain.

Among the personal variables the gender of the students has a strong effect on the probability of being at risk of school failure. Girls consistently perform better in the reading competence than males. The ratio 2 to 1 appears unvarying throughout the decade, indicating that male students have twice the probability of school failure risk compared to female students. However, it is not possible to determine if the superior performance of girls is long-lasting, due to the cross-section nature of the data. Also, the real importance of gender may be overestimated due to the specific selection of reading competence.

There is also a significant difference in the results for immigrant students compared to students born in Spain. This divergence is remarkably accentuated in the risk of school failure for first generation immigrants. The accumulation of a number of pre-conditions that seem to be characteristic of these particular students suggests that immigrant students begin from a situation of enormous disadvantage compared to national students. In this sense, policies that help to ease the process of integration of immigrants into Spanish society, and policies that increase the instruction time of immigrants in the schools, could have a positive impact on the academic performance of these students.

Household characteristics offer an important insight into the influence of the family environment on academic performance. Students with highly educated parents, belonging to the white-collar socio-professional category, along with the possession of cultural and educational resources at home show that these have a strong positive influence on the reduction of the risk of school failure. Differences in family background and the educational inputs at home seem to play a major role in academic achievement and results and act as a precondition already set before a child enters the school.

Among the school variables the location of the school in a geographical area where more than a million inhabitants live has a positive influence over the reduction of the school

failure risk, perhaps because of the availability of social, cultural and educational resources in more densely populated areas. After controlling for the socio-economic characteristics of the schools, the students in private and private publicly-funded educational institutions do not appear to have a lower risk of school failure than students from state schools.

Students in schools which over 20% of the school total population are immigrant students and in schools with a predominance of blue-collar families face a greater risk of school failure. In schools where parents with tertiary education are predominant, the risk to their students does not seem to decrease. Policies guaranteeing a more homogeneous distribution of immigrant students among schools, keeping ratios below 20%, could have a powerful effect on the students' academic performance. The strong impact of school composition variables on academic outcome seems to support the need to reduce the segregation of students between public and private publicly-funded schools.

The evolution of the determinants during these ten years shows a particularly stable behavior for personal characteristics throughout time becoming, in general, more significant during the last half of the decade. Gender is indeed important but, despite the consistency of the results through time, it is unclear whether the better performance of female students exists at all educational levels and areas of knowledge. Considering the household variables, most of them are also exceptionally stable during these ten years. Parental occupation deserves a special mention, appearing positively related to the risk of school failure by 2000 and then negatively related for the rest of the years. A possible hypothesis is that there is not necessarily a reduction in the risk of school failure for the economically active households, but maybe an increase in the risk for those families who are facing problems in the labor market due to the economic crisis.

In contrast to the first-level variables, most of the school determinants are not significant during the decade. However, this fact does not imply the nonexistence of a relation between these variables and school failure risk. One reason behind the non-significance of the school resources could be the specification of the model, focused on measuring the mean effects on the population sample. A possible alternative for future research is the analysis of heterogeneous effects by considering different subgroups.

Remarkably there are no differences in the risk of school failure between students attending private, private publicly-funded or state schools during the decade. The over-concentration of immigrant students in schools appears as a powerful factor positively associated with the risk during all of this period, along with a predominant concentration of blue-collar families in schools. The results suggest that the threshold at which the accumulation of immigrant students variable is significant has increased.

It must be acknowledged that the cross-sectional analysis of the study of school failure risk is a limitation of this research. This paper, however constrained by these restrictions, has still provided relevant information on the accumulative processes that surround school failure.

Future studies should simultaneously include the outcomes for the three competences and, ideally, should draw on panel data. Also, more detailed studies going more deeply into the question of immigrant students and the difficulty of measuring peer effects would be relevant in subsequent works.

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ANNEX A: Variance reduction analysis results

2000	Variance component	Standard Deviation	Chi-square	P-value
Null model	0.845	0.919	871.38	0.000
Full model	0.326	0.569	413.72	0.000

2003	Variance component	Standard Deviation	Chi-square	P-value
Null model	0.855	0.925	1479.38	0.000
Full model	0.478	0.690	1005.15	0.000

2006	Variance component	Standard Deviation	Chi-square	P-value
Null model	0.838	0.916	2716.51	0.000
Full model	0.465	0.681	2055.64	0.000

2009	Variance component	Standard Deviation	Chi-square	P-value
Null model	1.000	1.000	4697.29	0.000
Full model	0.583	0.763	3246.37	0.000

Note: The table reports the difference between the variance component for the unconditional model with random intercept (one-way ANOVA) and the full model. The table reports information about the outcome variability of within-group and between-group variance. The significant difference in the variance between groups in the four estimations justifies the use of hierarchical models.

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