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The influence of kindergarten on students' performance: the Spanish case

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Abstract

Most Spanish parents enrol their children in preschool education (ages 3-5) as a way of preparing them for compulsory education. However, not all parents decide to enrol their children in kindergarten (ages 0 to 2). In this context, the aim of the present study is to analyse the influence of kindergarten attendance on students' academic performance in 3rd and 6th grades. In order to address this issue, we employ census and longitudinal data from the Spanish region of the Canary Islands and an instrumental variable approach to go beyond simple correlation. Our results show that kindergarten attendance improves students' performance in around 1 standard deviation in 3rd grade, but that this influence is reduced and almost disappears when reaching 6th grade, particularly in reading.

Keywords: kindergarten; primary education; instrumental variables; reading; mathematics.

JEL Codes: I20, I21, I28.

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1. Introduction

All countries have their own education legislation that regulates when children must start compulsory education, it being considered illegal if parents decide not to take their children to school. However, before compulsory education, some countries also offer kindergarten, preschool or early childhood education services for children. Sometimes, parents decide to take their children to kindergarten so they can reconcile their work and family life (Penn, 2007) and/or to meet the child's social and cognitive developmental needs (Robertson, Gunn, Lanumata, & Pryor, 2007), also preparing them for compulsory education. The need to reconcile work and family has become even more relevant in recent decades, due to the incorporation of women to the labour market (Fortin, 2015). In addition, children from higher socio-economic status families tend to attend early childhood education centres more than those from lower socio-economic status families (Leseman, 2002; Zachrisson & Dearing, 2015; Magnuson & Waldfogel, 2016), partly due to the enrolment costs, so it is often subsidised for disadvantaged families (Ertas & Shields, 2012; Simpson & Envy, 2015).

In this context, the present study is focused on the period of kindergarten for children in Spain. In this country, compulsory education begins at age 6 (1st grade). The education received by students before this period is divided into kindergarten (age 0 to 2) and preschool education (age 3 to 5). In 2006, Spanish legislation implemented public funding for preschool education (Vélaz-de-Medrano, Manzano-Soto, & Turienzo, 2020), so it is now free for parents who want to enrol their children. However, in Spain kindergarten centres can be public or private. Most parents enrol their children in preschool education (age 3 to 5); nevertheless, this does not happen with kindergarten (age 0 to 2), as only 36.4% of children were enrolled in kindergarten in Spain in the 2016/17 academic year (Save the Children, 2019).

Previous research studies have remarked the positive influence that attending pre-primary (i.e. kindergarten and/or preschool) education could have on students' later academic performance. In this sense, Ramey, Campbell, Burchinal, Skinner, Gardner, and Ramey (2000) performed an experiment in which students in the treatment group were provided with preschool education in the first 5 years of their lives, finding that students receiving this kind of education performed better than those who did not, and that their mothers obtained higher levels of employment (for those mothers who were teenagers). Stipek and Byler (2001) performed a longitudinal analysis from kindergarten to 3rd grade, finding relatively higher academic performance during the first year of school of students who were enrolled in kindergarten at a relatively older age compared to their peers, but no influence in 3rd grade. Similarly, Fitzpatrick (2008) analysed 4th grade students in Georgia and found that students who went to kindergarten performed between 0.05 and 0.17 standard deviations better in reading and mathematics. Elder and Lutobsky (2009) indicated that this positive relationship between the age of enrolment in kindergarten and students' academic achievement in primary education was mainly due to the skills that relatively older students acquired before kindergarten. Furthermore, Osakwe (2009) analysed students from Nigeria and found that those enrolled in early childhood education had higher academic performance, cognitive ability, social skills and motor skills, while Andrews, Jargowsky, and Kuhne (2012) analysed the influence of preschool on students in Texas, finding that it was positively associated with higher scores in reading and mathematics in the future, lower likelihood of dropping out and lower likelihood of using special education services.

Other authors such as Gardinal-Pizato, Marturano, and Fontaine (2012) also found a positive influence of early childhood school attendance on Brazilian students' academic performance in 3rd, 4th and 5th grades. In the same vein, Cortázar (2015) analysed the influence of an early childhood education program on the academic performance of Chilean students in 4th grade, finding that it increased students' academic performance in reading by 0.19 standard deviations, by 0.23 standard deviations in mathematics and by 0.19 standard deviations in social sciences. Datta and Simonsen (2016) also found a positive influence of early childhood education of 0.20 standard deviations on Danish students' academic performance when finishing compulsory education. Interestingly, Bakken, Brown, and Downing (2017) analysed students from socioeconomically disadvantaged backgrounds in the United States who received high-quality early childhood education, finding that those who had it performed better in reading and mathematics in 4th grade. Therefore, most research studies seem to point towards the positive influence of pre-primary education enrolment on students' cognitive outcomes.

Previous evidence from meta-analyses also points towards this conclusion. For instance, Nelson, Westhues, and MacLeod (2003) performed a meta-analysis of 34 studies and found an effect size of kindergarten on cognitive outcomes during the preschool period (effect size of 0.52) which lasted until 8th grade, although to a lower extent (effect size of 0.30). Cooper, Allen, Patall, and Dent (2010) carried out a meta-analysis on 40 studies and found a one quarter of standard deviation increase in academic performance when finishing kindergarten, but this association disappeared in 3rd grade. Likewise, Magnuson, Kelchen, Duncan, Schindler, Shager, and Yoshikawa (2016) performed a meta-analysis of 23 studies regarding early childhood education, finding that it positively influenced students' academic performance in 0.20 standard deviations, without differences between boys and girls.

The analysis of this issue for Spain is scarce and has only focused on a correlational approach. For example, Hidalgo-Hidalgo and García-Pérez (2012) studied the relationship of pre-primary education (age 0 to 5) attendance with the academic performance of 4th grade Spanish students who took TIMSS³, finding that students who had it performed 3% better in reading, mathematics and science, this positive influence being higher for students born in the last term of the year from lower socio-economic status families. González-Betancor and López-Puig (2015) analysed the influence of kindergarten (age 0 to 2) on the academic achievement of Spanish students in fourth grade, finding a positive influence that helped students who were born in the fourth quarter of the year obtain better academic results, thus compensating their lower academic performance due to their relative age. Santin and Sicilia (2015) analysed 4th grade primary education students in Madrid, finding that one additional year of pre-primary education increased students' academic performance by 4.4% in reading and 6% in mathematics.

From a theoretical perspective, a large body of literature in the field of psychology has dealt with "developmental theories", which focus on explaining child development, early childhood education, and care. The five main theories that have had the most impact are the constructivist, behavioural, psychoanalytic, maturationist and ecological theories. As stated by Saracho (2021), these theories suggest that elements in the child's genetic makeup and the environmental conditions influence development and behaviour and how these elements are related. In other words, they offer insights about how the performance of individuals is stimulated, sustained and encouraged. In summary, a relevant

³ TIMSS stands for "Trends in International Mathematics and Science Study".

characteristic of constructivism is that children, rather than teachers, assume the responsibility for learning, whereas in behaviourism, teachers assume the responsibility for learning instead of the children, because they think that educators can control the environment to adjust the children's behaviour and, by doing that, they can alter individuals' ability. Thus, behaviourists rely on nurture, as opposed to the maturationists (Hunt, 1961), who consider that individuals' hereditary traits (nature) determine the children's capacity for development, i.e., as individuals develop their genetic aptitude progresses. In the case of the psychoanalytic theories, they considered that young children's problem solving is essential for their mental health and adult life; explicitly, Murphy (1962) stated that music, art, movements and, in general, play offer useful instruments to cope and solve difficulties at their personal level, and these activities can be particularly developed by attending kindergarten. Last, but not least, for the ecological theory, the key issue in children's development is the environment, which is a mix of children's interactions with both classroom and family environments. Despite the potential value of these theories as a whole, they do not offer a straight explanation for the empirical results we have found, as we briefly discuss in the discussion and conclusions section.

Specifically, in the present study, we adopt an empirical approach to evaluate the influence of kindergarten on students' academic performance in 3rd and 6th grades as analysed using a recent dataset for primary education students in the Spanish region of the Canary Islands. This is an outermost region of Spain, which presents the lowest level of academic performance within the country, far from the OECD average. The results from the last cycle of PISA⁴ (2018) highlight an academic performance of 5 points below the Spanish average and 15 points below the OECD average in reading (MEFP, 2020), whereas it presents 20 points below the Spanish average and 30 points below the OECD average in mathematics (MEFP, 2018). In addition, this region has a large number of students who did not achieve the basic level of competences in PISA 2018 in reading (23% of students performed below level 2, a figure which was 25% for Spain and 24% for the OECD, MEFP, 2020) and in mathematics (32% of students performed below level 2, a figure which decreased to 22% for Spain and 21% for the OECD, MEFP, 2018). According to Save the Children (2019), around 16.6% of infants eligible to attend kindergarten in Canary Islands were actually enrolled in it in the 2016-17 academic year. Specifically, the dataset employed in the present study for this region has several strengths. First, it is rich in variables, with a recent census dataset of primary education students attending 3rd grade in 2015-16. Secondly, these students can be tracked in 6th grade (2018-19 academic year), presenting a panel structure.

In particular, the aim of the present study is to answer the following research question:

Does attending kindergarten improve students' academic performance in 3rd and 6th grades in the Canary Islands?

In order to achieve this aim, an instrumental variables analysis has been performed, which enables us to obtain results that can go beyond correlation, in contrast to the previous research studies for Spain (Hidalgo-Hidalgo & García-Pérez, 2012; González-Betancor & López-Puig, 2015; Santin & Sicilia, 2015). Thus, this research study is novel in two ways: (a) it is the first time that this issue has been analysed for

⁴ PISA stands for "Programme for International Student Assessment".

Spain going beyond correlation; (b) it is the first time that the long-term influence of kindergarten attendance is analysed for Spain.

The rest of the paper is structured as follows: first, the data under analysis is described, followed by the methodology, the results obtained, their discussion and conclusions.

2. Data

In the present study we employ census data from the Spanish region of the Canary Islands, collected by the Canarian Agency for University Quality and Educational Assessment (*Agencia Canaria de Calidad Universitaria y Evaluación Educativa*). The information employed in this research study is from the cohort of students attending 3rd grade in the 2015-16 academic year, who could be followed in 6th grade in the 2018-19 academic year.

In particular, this assessment is aimed at measuring students' competences in reading and mathematics. The reading test intends to measure students' skills in understanding and producing written texts, as well as Spanish language listening comprehension. The mathematics test is aimed at measuring students' skills in geometry, algebra and skills with numbers. The measurement of these competences is regulated in the Spanish education legislation (BOE, 2013), which indicates that this has to be done in 3rd grade and 6th grade. In addition, students, their parents and the school (i.e. the head teacher) also answered background questionnaires. In the parental questionnaire, parents report the age at which their children began to attend kindergarten (0 to 2 years old), early childhood education (3 to 5 years old) or compulsory education (starting at age 6), which will be the main variable under analysis in this research study. The students of this dataset were born in 2007 (Vélaz-de-Medrano, Manzano-Soto, & Turienzo, 2020), and were thus able to access to publicly funded early childhood education and also to public or private kindergarten centres, thus leaving the enrolment decision only to their parents.

From a total of 18,343 students, repeater students were not included in the sample (as they may present a different education production function compared to non-repeaters; García-Pérez, Hidalgo-Hidalgo, & Robles-Zurita, 2014), leaving the sample with 16,542 students. This sample was then reduced to 12,356 students after removing students whose parents did not report information about school attendance and students who did not have information about their reading or mathematics competences. In order to check if there is any attrition, descriptive statistics and a test of mean differences between the socio-economic characteristics of the non-repeater population and the final sample have been reported in Table A1 (Appendix). Some variables show significant differences, so they are going to be controlled in our model.

3. Methodology

3.1. Initial model

In order to analyse the influence of attending kindergarten on students' academic performance, the following model is specified:

$$A_{ijrt} = \alpha + \beta K_{ijrt} + \gamma X_{ijrt} + \delta F_{ijrt} + \vartheta SCH_{jrt} + \phi REG_{rt} + \varepsilon_{ijrt} \quad (1)$$

where i is the individual, j the school, r is the region of Canary Islands and t is the grade ($t = 1$ for 3rd grade and $t = 2$ for 6th grade); A_{ijrt} are students' standardised scores in

reading and mathematics (alternatively)⁵; K_{ijrt} is a dummy variable which takes the value “1” when the student attended kindergarten and “0” otherwise; X_{ijrt} are students’ background characteristics (i.e. sex, immigrant status, month of birth); F_{ijrt} are family characteristics (level of education of the father and the mother, occupation of the father and the mother, number of books at home); SCH_{jrt} are school characteristics (school funding); REG_{rt} is the region of the Canary Islands; ε_{ijrt} is the idiosyncratic error term.

The estimated β coefficient obtained from this model shows the influence of kindergarten attendance on students’ academic performance in reading and mathematics, controlling for a wide array of observable characteristics. Nevertheless, potential unobservables included in ε_{ijrt} which have been omitted from the model might bias this β coefficient (e.g. students’ ability), insofar as they may be correlated with K_{ijrt} , making it an endogenous regressor (i.e., not exogenous, as would be necessary). An example of this correlation could be, for instance, an infant whose parents perceive he/she is skilled enough and thus think that their child does not need to attend kindergarten or, alternatively, an infant who is not skilled enough and their parents decide to enrol him/her in kindergarten. In these cases, the ordinary least squares (OLS) estimates of β might be biased due to the omission of students’ unobservables in the regression such as, in this case, student’s ability. This is a common issue when working with cross-sectional data, as many authors have pointed out (Hanchane & Mostafa, 2010; Lounkaew, 2013; Cordero & Pedraja, 2019). Therefore, an instrumental variable approach has been applied to solve this problem by using two-stage least squares (2SLS).

3.2. Two-stage least squares

This methodology requires the identification of an instrument (Z_{ijrt}) and the use of other control variables (X_{ijrt} , F_{ijrt} , SCH_{jrt} , REG_{rt}) to try to erase any potential confounder on the relationship between students’ academic performance and kindergarten attendance. Basically, any instrument that we choose has to be highly correlated with the endogenous variable that it intends to instrumentalise (i.e. K_{ijrt}) and not correlated with the unobservables (i.e., it has to be exogenous); therefore, this means that the instrument has to be very similar to the endogenous variable, but cannot have the same problem of correlation with the unobservables. The instrument that is going to be employed is the mother’s employment situation in 3rd grade⁶ (which is denoted as Z_{ijrt}), and presents the following five categories: “full time worker”, “part-time worker”, “unemployed”, “retired” and “does not have and does not search for a job”. This is a categorical variable which is decomposed into binary variables, each one representing a category.

The previously indicated characteristics that the instrument has to present can be assured if the latter fulfils the following properties:

- (a) The *relevance condition* or *first stage*. This condition indicates that the instrument should be strongly associated with the treatment variable (K_{ijrt}). This

⁵ These scores have been standardised to have mean 0 and standard deviation 1, using the mean and standard deviation of the population, so results can be interpreted as effect sizes, which is useful for international comparisons.

⁶ Father’s employment situation in 3rd grade has also been employed as a robustness check, although it does not work as an instrument. This is a logical result, to the extent that in Spain care tasks are usually performed by the mother. These estimations will be provided by the authors upon request.

is the case in the present study, as attending kindergarten is strongly linked to the mother's employment situation in 3rd grade (Z_{ijrt}). This is because mothers' employment situation may condition family income as well as the time parents have to take care of their children while very young, a task which is usually performed by the mother (Merighi, Jesus, Domingos, Oliveira, & Baptista, 2011; Christopher, 2012; Chesley, 2016). This point is going to be formally illustrated using the Stock and Yogo (2005) test of weak instruments presented in the results section below.

(b) The *independence/exogeneity assumption*. This condition establishes that the instrument is randomly assigned or "as good as randomly assigned", meaning that it is uncorrelated to the omitted variables we might like to control for. In this research study, the mother's employment situation in 3rd grade might be considered as good as randomly assigned after controlling by X_{ijrt} , F_{ijrt} , SCH_{jrt} and REG_{rt} , to the extent that her education and occupation would be controlling by the influence of the mother's human capital, leaving for the instrument the exogenous personal decision of the mother to take her children to kindergarten depending on her employment situation.

(c) The *exclusion restriction*. This condition establishes that there is a single channel (that is, through K_{ijrt}) for the influence of the instrument (mother's employment situation, Z_{ijrt}) on the outcome (students' standardised reading and mathematics scores, A_{ijrt}). This single channel requires that the independence assumption is fulfilled, so that other potential channels for this influence have been controlled for (X_{ijrt} , F_{ijrt} , SCH_{jrt} , REG_{rt}).

(d) The *monotonicity property* (Fiorini & Stevens, 2014; Barua & Lang, 2016; Dhuey, Figlio, Karbownik, & Roth, 2019). As Barua and Lang (2016) indicated, "while the instrument may have no effect on some individuals, all of those who are affected should be affected unidirectionally" (p. 348). This condition is also defined as the *no defiers assumption*, which means that there are no infants who decide not go to kindergarten when they are enrolled by their parents and, likewise, if they are not enrolled by their parents to attend kindergarten, they always decide to attend kindergarten. This monotonicity is always fulfilled in the data, as infants are too young to make a decision contrary to their parents'.

Once this instrument has been chosen, the model in equation (1) can then be estimated using two-stage least squares (2SLS). The *first stage* of this methodology is defined as:

$$K_{ijrt} = \pi_0 + \pi_1 Z_{ijrt} + \pi_2 X_{ijrt} + \pi_3 F_{ijrt} + \pi_4 SCH_{jrt} + \pi_5 REG_{rt} + \omega_{ijrt} \quad (2)$$

where ω_{ijrt} is the idiosyncratic error term. Once this equation has been estimated, a prediction of the kindergarten attendance variable is obtained (\hat{K}_{ijrt}), which is pretty similar to K_{ijrt} (due to the high correlation with it), but is not correlated with the unobservables (as this prediction is isolated from these unobservables), and is thus exogenous. Then, \hat{K}_{ijrt} will be included in the model of equation (1) to create the *reduced form* in the second stage of this methodology (hereinafter the base model):

$$A_{ijrt} = \alpha + \beta \hat{K}_{ijrt} + \gamma X_{ijrt} + \delta F_{ijrt} + \vartheta SCH_{jrt} + \phi REG_{rt} + \varepsilon_{ijrt} \quad (3)$$

where β indicates the influence of kindergarten attendance on students' academic performance in reading and mathematics, respectively. The results obtained will be checked using the Stock and Yogo (2005) test of weak instruments and the Wooldridge (1995) endogeneity test.

Nevertheless, in spite of this methodology, the present research study has some limitations. First, the instrument that is employed is measured in 3rd grade, although the optimal instrument would be one measured during the years in which infants can be enrolled in kindergarten. Second, this study has high internal validity for the region of the Canary Islands, but the external validity is constrained, as the particular case of each region and country has to be analysed individually.

4. Results

The main results for the base model in equation (3) for 3rd grade are presented in Table 1. First stage results (equation 2) show that the instrument is relevant to explain kindergarten attendance, hence indicating that the instrument is not weak. This, together with the results of the Stock and Yogo (2005) test of weak instruments, indicates that the instrument is strongly associated to kindergarten attendance, so the *relevance condition* is satisfied. Then, the results for the reduced form show an influence of kindergarten attendance of around 0.9 standard deviation in reading (at 10% of significance) and 1.2 standard deviation in mathematics (at 5% of significance). The Wooldridge (1995) endogeneity test indicates that, after estimating this model by two-stage least squares, the endogeneity of the kindergarten attendance variable has been solved. Therefore, we can conclude that our two-stage least squares approach has solved the endogeneity issues which might influence the kindergarten attendance variable when explaining students' academic performance.

-Insert Table 1 here-

In Table 2, these estimations are replicated for the same students in 6th grade. The positive influence of kindergarten attendance seems to diminish, disappearing in reading and becoming significant at 10% in mathematics, with slightly lower influence (0.924 standard deviations). Thus, it seems that, in the long term, the influence of kindergarten attendance is reduced (as found by authors such as Stipek & Byler, 2001; Nelson, Westhues, & MacLeod, 2003), although it remains significant in mathematics.

-Insert Table 2 here-

As a robustness check, repeater students were included in the estimation, showing the results in Tables A2 and A3 (Appendix). It can be seen that results are robust, as they are very similar to those presented in Tables 1 and 2.

5. Discussion and conclusions

In this analysis we explore the influence of kindergarten attendance on students' academic performance in 3rd and 6th grades. Census data from the Spanish region of Canary Islands and an instrumental variable approach, to go beyond correlation, have been employed for this analysis. Our results show that kindergarten attendance improves students' performance by around 1 standard deviation in 3rd grade, but that this influence is reduced and almost disappears when reaching 6th grade, particularly in reading. Hence, this human capital accumulation (Cunha, Heckman, Lochner, & Masterov, 2006; Elder & Lubotsky, 2009) provided by kindergarten attendance seems positive for students at early ages. However, as students grow older this positive influence diminishes in reading,

but not in mathematics. This differential influence between reading and mathematics may be explained by the fact that linguistic skills are more affected by the home environment than mathematics (Ozturk & Singh, 2006). Hence, as students reach higher primary school grades, the differential influence between those who attended kindergarten and those who did not fades in respect to reading. To some extent, this argument can be considered consistent with the ecological theory, as far as children's interaction with the classroom and family environments could affect their differential development. However, it does not explain the differences observed between reading and mathematics. The same applies to the constructivist theorist (Vygotsky, 1978), which claims that when children's language environments are limited to direct speech and the popular media, their potential as thinkers and users of language is thwarted. In fact, Vygotsky (1978) claimed that learning needs to be practical in the children's environment; specifically, it must be appropriately based on their daily lives and the practices of their community or culture. The other developmental theories do not offer a clear explanation of our results either.

Regarding the better performance in mathematics up to 6th grade of children attending kindergarten, this might be because kindergarten attendance contributes to the development of this ability due to daily exposure to experiences with numbers for a longer period of time, which let a prolonged human capital accumulation (Cunha, Heckman, Lochner, & Masterov, 2006; Elder & Lubotsky, 2009). Hence students who start elementary education with the best numerical competence progress faster in learning arithmetic (Jordan, Kaplan, Ramineni, & Locuniak, 2009). Another alternative explanation might be that kindergarten also favours the early acquisition of conducts and behaviours that, as indicated in the literature, could be particularly relevant for progress in mathematics: for instance, better attention (Fuchs, Fuchs, Stuebing, Fletcher, Hamlett, & Lambert, 2008), persistence and organisation (Di Perna, Lei, & Reid, 2007). Therefore, kindergarten may help students in the development of non-academic skills for school and life (Sassi, 2011).

In spite of the positive features of kindergarten, there is no consensus in the field of universal versus targeted kindergarten educational policies (Santin & Sicilia, 2015; Magnuson & Waldfogel, 2016). According to authors such as e.g. Esping-Andersen (2004) and Bradbury, Corak, Waldfogel, and Washbrook (2015), the most appropriate approach would be investing in universal kindergarten instead of a system targeted to infants from low socio-economic backgrounds, as is the case for children aged 3 to 5 in Spain. This approach is based on the idea that, if kindergarten is left to the market, inequalities will emerge but, if it is universally provided, then low-income children will benefit more from this policy than more advantaged children. In this sense, although there are public kindergarten options in Spain, spots are limited and not available for all children. Nevertheless, other authors indicate that the government should increase kindergarten subsidies to make this kind of early education more affordable for low-income families and/or fostering specific programmes targeted to low-income families (Duncan & Magnuson, 2003), based on the idea that low-income children will benefit more than affluent children. Both government funding systems should also include educational facilities (classrooms, instructional materials and equipment; Osakwe, 2009). Publicity and awareness-raising campaigns outlining the importance of kindergarten may also be useful to make parents more aware of its importance and to foster participation in this education (Osakwe, 2009). Furthermore, for students who did not attend kindergarten, compensation programs might be useful at an early stage in primary education, in order to give them the advantage of students who did go to kindergarten

Therefore, fostering and funding access to kindergarten may not only improve students' subsequent academic performance, but may also provide more equality of opportunities to students who come from disadvantaged families (Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005; Gardinal-Pizato, Marturano, & Fontaine, 2012) and are less likely to have attended kindergarten.

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Appendix

-Insert Table A1-

-Insert Table A2-

-Insert Table A3-

Table 1. The influence of kindergarten attendance on students' academic performance, 3rd grade

Variables	First stage	Reduced form	
		Reading	Mathematics
Attendance to kindergarten: yes (ref.: no)	-	0.865*	1.216**
		(0.498)	(0.582)
Instrument: mother's labour situation in 3 rd grade (ref.: does not have and does not search for a job)			
Full time worker	0.065**	-	-
	(0.027)		
Part-time worker	0.057**	-	-
	(0.028)		
Unemployed	0.017	-	-
	(0.027)		
Retired	0.080	-	-
	(0.066)		
Mother's labour situation in 3 rd grade. Missing flag	-0.037	-	-
	(0.035)		
Sex: female (ref.: male)	-0.004	0.248***	-0.063***
	(0.008)	(0.017)	(0.022)
Sex. Missing flag	-	-	-
Immigrant status (ref.: native)			
First generation immigrant	-0.166***	-0.021	0.202
	(0.029)	(0.125)	(0.158)
Second generation immigrant	-0.016	-0.030	-0.014
	(0.018)	(0.042)	(0.050)
Immigrant status. Missing flag	-0.046	-0.155	-0.317
	(0.031)	(0.212)	(0.247)
Month of birth (ref.: December)			
January	0.182***	0.129	0.111
	(0.019)	(0.096)	(0.109)
February	0.199***	0.089	0.081
	(0.019)	(0.111)	(0.125)
March	0.169***	0.056	0.052
	(0.020)	(0.099)	(0.114)
April	0.164***	0.043	0.035
	(0.019)	(0.093)	(0.108)
May	0.175***	0.052	0.005
	(0.020)	(0.092)	(0.107)
June	0.203***	-0.068	-0.039
	(0.020)	(0.111)	(0.129)
July	0.154***	-0.002	-0.003
	(0.020)	(0.086)	(0.097)
August	0.175***	-0.104	-0.085
	(0.019)	(0.092)	(0.106)
September	0.032*	0.037	0.093*
	(0.019)	(0.044)	(0.050)
October	0.022	-0.011	0.078
	(0.019)	(0.046)	(0.049)
November	0.006	-0.031	0.048
	(0.019)	(0.042)	(0.048)
Month of birth. Missing flag	-	-	-
Level of education of the father (ref.: did not go to school)			
Did not finish compulsory education	-0.079	-0.023	0.163
	(0.055)	(0.139)	(0.157)
Compulsory education	-0.076	0.049	0.191
	(0.055)	(0.141)	(0.158)
High school or medium professional track	-0.059	0.095	0.259*
	(0.056)	(0.137)	(0.153)
High professional track	-0.034	0.119	0.289*
	(0.057)	(0.138)	(0.155)
3-year university degree	-0.049	0.143	0.331**
	(0.058)	(0.143)	(0.158)
4-year university degree	-0.044	0.225	0.377**
	(0.058)	(0.143)	(0.157)
Master	-0.059	0.241	0.261
	(0.067)	(0.156)	(0.168)
PhD	-0.007	0.082	0.008
	(0.079)	(0.177)	(0.191)
Level of education of the father. Missing flag	-0.054	-0.135	0.091

	(0.057)	(0.141)	(0.153)
Level of education of the mother (ref.: did not go to school)			
Did not finish compulsory education	-0.021 (0.077)	0.069 (0.177)	-0.123 (0.213)
Compulsory education	0.002 (0.077)	0.146 (0.175)	-0.005 (0.214)
High school or medium professional track	0.034 (0.077)	0.194 (0.183)	0.000 (0.221)
High professional track	0.051 (0.078)	0.184 (0.184)	-0.002 (0.221)
3-year university degree	0.071 (0.078)	0.276 (0.189)	0.050 (0.225)
4-year university degree	0.096 (0.079)	0.267 (0.192)	0.132 (0.229)
Master	0.089 (0.084)	0.248 (0.196)	0.272 (0.231)
PhD	0.187* (0.096)	0.287 (0.222)	0.232 (0.275)
Level of education of the mother. Missing flag	0.094 (0.082)	-0.004 (0.317)	-0.314 (0.385)
Occupation of the father (ref.: never had a job)			
Non-specialised worker	-0.046 (0.077)	0.092 (0.181)	-0.113 (0.200)
Specialised worker of artisan	-0.031 (0.078)	0.065 (0.181)	-0.133 (0.196)
Specialised worker in agriculture, ranching or fishing	-0.030 (0.079)	0.025 (0.184)	-0.162 (0.205)
Machinery operator in factory or garage	-0.030 (0.078)	0.034 (0.180)	-0.174 (0.197)
Services worker in hotels and shops	-0.036 (0.077)	0.088 (0.179)	-0.100 (0.195)
Personal services worker, protection and security	-0.015 (0.079)	0.064 (0.178)	-0.180 (0.197)
Owner of a little business	0.031 (0.078)	0.045 (0.178)	-0.255 (0.194)
Administrative	0.001 (0.079)	0.179 (0.179)	-0.074 (0.197)
Technicians or helps	0.003 (0.078)	0.131 (0.178)	-0.119 (0.196)
Manager or high civil servant	0.010 (0.079)	0.108 (0.181)	-0.097 (0.199)
Professionals	-0.018 (0.077)	0.114 (0.176)	-0.161 (0.193)
Occupation of the father. Missing flag	0.002 (0.077)	0.043 (0.176)	-0.226 (0.193)
Occupation of the mother (ref.: never had a job)			
Non-specialised worker	0.067** (0.033)	-0.022 (0.085)	-0.058 (0.096)
Specialised worker of artisan	0.111*** (0.037)	0.031 (0.118)	-0.062 (0.138)
Specialised worker in agriculture, ranching or fishing	0.046 (0.045)	0.045 (0.112)	0.055 (0.129)
Machinery operator in factory or garage	0.059 (0.073)	0.103 (0.186)	0.047 (0.197)
Services worker in hotels and shops	0.095*** (0.032)	-0.011 (0.095)	-0.050 (0.108)
Personal services worker, protection and security	0.160*** (0.041)	-0.042 (0.137)	-0.171 (0.157)
Owner of a little business	0.114*** (0.038)	-0.042 (0.108)	-0.056 (0.125)
Administrative	0.156*** (0.033)	-0.029 (0.113)	-0.089 (0.131)
Technicians or helps	0.152*** (0.036)	-0.087 (0.124)	-0.152 (0.146)
Manager or high civil servant	0.105*** (0.040)	0.014 (0.117)	-0.026 (0.139)
Professionals	0.130*** (0.035)	-0.013 (0.111)	-0.088 (0.131)
Occupation of the mother. Missing flag	0.089*** (0.033)	-0.089 (0.104)	-0.140 (0.125)
Number of books at home (ref.: 0 to 10 books)			
11 to 50	0.004 (0.014)	0.140*** (0.032)	0.087** (0.036)
51 to 100	-0.001	0.224***	0.172***

	(0.016)	(0.034)	(0.040)
101 to 200	-0.002	0.229***	0.156***
	(0.019)	(0.042)	(0.049)
More than 200	0.000	0.282***	0.297***
	(0.020)	(0.044)	(0.048)
Number of books at home. Missing flag	-0.065	-1.037	-2.070
	(0.042)	(1.671)	(1.946)
Region (ref.: non-capitalina)			
Gran Canaria	0.016	0.062	0.132*
	(0.013)	(0.049)	(0.079)
Tenerife	-0.014	0.088*	0.259***
	(0.013)	(0.049)	(0.080)
Region. Missing flag	-	-	-
School funding (ref.: public)			
Private	0.119***	-0.044	-0.012
	(0.010)	(0.076)	(0.096)
School funding. Missing flag	-	-	-
Constant	0.454***	-1.042***	-0.991**
	(0.109)	(0.342)	(0.407)
Observations	12,356	12,356	12,356
Stock and Yogo (2005) test of weak instruments	-	5.805***	5.805***
Wooldridge (1995) endogeneity test	-	2.501	3.729

Notes: Standard errors are in parenthesis and robust. It has been controlled by a variable that indicates that the information from the kindergarten variable was recovered from 6th grade data. The null hypothesis of the Stock and Yogo (2005) test of weak instruments is that the instrument is weak and the null hypothesis of the Wooldridge (1995) endogeneity test is that the endogenous variable is now exogenous.

Estimation method: Two-Stage Least Squares (2SLS). The instrument is mother's labour situation.

Dependent variable: First stage: Kindergarten attendance ("1" for "Yes" and "0" for "No"). Reduced form: Students' standardised scores in reading and mathematics.

Coefficient: *** significant at 1%, ** significant at 5%, * significant at 10%.

Source: Authors' own calculations.

Table 2. The influence of kindergarten attendance on students' academic performance, 6th grade

Variables	First stage	Reduced form	
		Reading	Mathematics
Attendance to kindergarten: yes (ref.: no)	-	-0.202 (0.534)	0.924* (0.537)
Instrument: mother's labour situation in 3 rd grade (ref.: does not have and does not search for a job)			
Full time worker	0.067** (0.027)	-	-
Part-time worker	0.058** (0.028)	-	-
Unemployed	0.018 (0.027)	-	-
Retired	0.078 (0.066)	-	-
Mother's labour situation in 3 rd grade. Missing flag	-0.036 (0.035)	-	-
Sex: female (ref.: male)	-0.004 (0.008)	0.275*** (0.020)	-0.074*** (0.020)
Sex. Missing flag	-	-	-
Immigrant status (ref.: native)			
First generation immigrant	-0.167*** (0.029)	-0.057 (0.126)	0.220 (0.138)
Second generation immigrant	-0.017 (0.018)	-0.016 (0.050)	0.024 (0.049)
Immigrant status. Missing flag	-0.047 (0.031)	0.090 (0.191)	-0.156 (0.229)
Month of birth (ref.: December)			
January	0.181*** (0.019)	0.242** (0.101)	-0.003 (0.105)
February	0.199*** (0.020)	0.155 (0.113)	0.006 (0.117)
March	0.169*** (0.020)	0.161 (0.104)	-0.024 (0.107)
April	0.164*** (0.019)	0.185* (0.100)	-0.061 (0.102)
May	0.174*** (0.020)	0.167* (0.099)	-0.018 (0.099)
June	0.204*** (0.020)	0.121 (0.119)	-0.133 (0.123)
July	0.155*** (0.020)	0.063 (0.090)	-0.080 (0.091)
August	0.175*** (0.019)	0.020 (0.101)	-0.176* (0.101)
September	0.033* (0.019)	0.040 (0.043)	-0.004 (0.046)
October	0.021 (0.019)	0.030 (0.043)	0.021 (0.045)
November	0.007 (0.019)	-0.024 (0.043)	0.051 (0.044)
Month of birth. Missing flag	-	-	-
Level of education of the father (ref.: did not go to school)			
Did not finish compulsory education	-0.081 (0.056)	-0.074 (0.137)	-0.122 (0.161)
Compulsory education	-0.078 (0.055)	0.005 (0.138)	-0.035 (0.159)
High school or medium professional track	-0.061 (0.056)	0.081 (0.135)	0.001 (0.156)
High professional track	-0.034 (0.057)	0.159 (0.134)	0.071 (0.158)
3-year university degree	-0.049 (0.058)	0.067 (0.136)	0.084 (0.163)
4-year university degree	-0.043 (0.058)	0.189 (0.137)	0.212 (0.160)
Master	-0.055 (0.067)	0.112 (0.164)	0.119 (0.186)
PhD	-0.005 (0.079)	0.114 (0.166)	0.036 (0.200)
Level of education of the father. Missing flag	-0.057	-0.101	-0.098

	(0.057)	(0.134)	(0.154)
Level of education of the mother (ref.: did not go to school)			
Did not finish compulsory education	-0.017 (0.077)	0.047 (0.156)	0.061 (0.203)
Compulsory education	0.006 (0.077)	0.009 (0.158)	0.105 (0.198)
High school or medium professional track	0.038 (0.077)	0.079 (0.162)	0.124 (0.206)
High professional track	0.054 (0.078)	0.108 (0.164)	0.121 (0.205)
3-year university degree	0.075 (0.078)	0.197 (0.167)	0.203 (0.213)
4-year university degree	0.101 (0.079)	0.226 (0.172)	0.200 (0.216)
Master	0.089 (0.084)	0.143 (0.184)	0.324 (0.219)
PhD	0.187* (0.096)	0.602*** (0.224)	0.437 (0.276)
Level of education of the mother. Missing flag	0.097 (0.082)	0.253 (0.292)	-0.030 (0.365)
Occupation of the father (ref.: never had a job)			
Non-specialised worker	-0.046 (0.077)	-0.107 (0.182)	-0.095 (0.213)
Specialised worker of artisan	-0.031 (0.078)	-0.051 (0.179)	-0.104 (0.218)
Specialised worker in agriculture, ranching or fishing	-0.031 (0.079)	-0.130 (0.185)	-0.242 (0.221)
Machinery operator in factory or garage	-0.029 (0.078)	-0.058 (0.179)	-0.172 (0.219)
Services worker in hotels and shops	-0.036 (0.077)	-0.069 (0.176)	-0.085 (0.214)
Personal services worker, protection and security	-0.014 (0.079)	-0.075 (0.182)	-0.098 (0.221)
Owner of a little business	0.032 (0.078)	-0.128 (0.176)	-0.233 (0.218)
Administrative	0.003 (0.079)	0.006 (0.181)	-0.069 (0.216)
Technicians or helps	0.003 (0.078)	-0.038 (0.179)	-0.089 (0.216)
Manager or high civil servant	0.010 (0.079)	-0.030 (0.182)	-0.082 (0.221)
Professionals	-0.018 (0.077)	-0.060 (0.178)	-0.095 (0.218)
Occupation of the father. Missing flag	0.001 (0.077)	-0.033 (0.175)	-0.246 (0.213)
Occupation of the mother (ref.: never had a job)			
Non-specialised worker	0.066** (0.033)	-0.057 (0.081)	-0.123 (0.095)
Specialised worker of artisan	0.109*** (0.037)	0.046 (0.119)	-0.105 (0.131)
Specialised worker in agriculture, ranching or fishing	0.047 (0.045)	-0.143 (0.109)	-0.051 (0.126)
Machinery operator in factory or garage	0.059 (0.073)	0.103 (0.147)	-0.005 (0.209)
Services worker in hotels and shops	0.094*** (0.032)	-0.008 (0.093)	-0.116 (0.107)
Personal services worker, protection and security	0.159*** (0.041)	-0.012 (0.132)	-0.202 (0.152)
Owner of a little business	0.114*** (0.038)	0.034 (0.112)	-0.048 (0.125)
Administrative	0.155*** (0.033)	-0.028 (0.116)	-0.155 (0.124)
Technicians or helps	0.152*** (0.036)	-0.064 (0.124)	-0.221 (0.134)
Manager or high civil servant	0.107*** (0.040)	-0.058 (0.125)	-0.104 (0.135)
Professionals	0.130*** (0.035)	-0.026 (0.113)	-0.147 (0.125)
Occupation of the mother. Missing flag	0.090*** (0.033)	-0.171* (0.103)	-0.196 (0.120)
Number of books at home (ref.: 0 to 10 books)			
11 to 50	0.003 (0.014)	0.113*** (0.033)	0.124*** (0.031)
51 to 100	-0.002	0.167***	0.201***

	(0.016)	(0.036)	(0.037)
101 to 200	-0.002	0.172***	0.176***
	(0.019)	(0.043)	(0.046)
More than 200	-0.000	0.302***	0.295***
	(0.020)	(0.044)	(0.044)
Number of books at home. Missing flag	-0.060	1.018	-0.658
	(0.042)	(1.508)	(1.793)
Region (ref.: non-capitalina)			
Gran Canaria	0.018	0.212***	-0.070
	(0.012)	(0.071)	(0.062)
Tenerife	-0.010	0.067	0.040
	(0.012)	(0.074)	(0.065)
Region. Missing flag	-	-	-
School funding (ref.: public)			
Private	0.112***	0.058	-0.024
	(0.010)	(0.091)	(0.081)
School funding. Missing flag	-	-	-
Constant	0.450***	-0.260	-0.482
	(0.109)	(0.373)	(0.414)
Observations	12,356	12,356	12,356
Stock and Yogo (2005) test of weak instruments	-	6.002***	6.002***
Wooldridge (1995) endogeneity test	-	0.014	3.194

Notes: Standard errors are in parenthesis and robust. It has been controlled by a variable that indicates that the information from the kindergarten variable was recovered from 6th grade data. The null hypothesis of the Stock and Yogo (2005) test of weak instruments is that the instrument is weak and the null hypothesis of the Wooldridge (1995) endogeneity test is that the endogenous variable is now exogenous.

Estimation method: Two-Stage Least Squares (2SLS). The instrument is mother's labour situation.

Dependent variable: First stage: Kindergarten attendance ("1" for "Yes" and "0" for "No"). Reduced form: Students' standardised scores in reading and mathematics.

Coefficient: *** significant at 1%, ** significant at 5%, * significant at 10%.

Source: Authors' own calculations.

Table A1. Descriptive statistics and test of mean differences between the non-repeater population and the sample under analysis

Variables		Non-repeater population		Sample	
		Mean	S.d.	Mean	S.d.
Sex of the student	Male	0.50 ^D	0.50	0.52 ^D	0.50
	Female	0.50 ^D	0.50	0.48 ^D	0.50
Immigrant status	Native	0.89 ^D	0.31	0.85 ^D	0.35
	First generation immigrant	0.03	0.16	0.04	0.19
	Second generation immigrant	0.08 ^D	0.27	0.11 ^D	0.31
Month of birth	January	0.09	0.28	0.08	0.27
	February	0.08	0.27	0.07	0.26
	March	0.08 ^D	0.27	0.09 ^D	0.29
	April	0.08	0.28	0.08	0.26
	May	0.08	0.27	0.08	0.27
	June	0.07	0.26	0.08	0.27
	July	0.08	0.27	0.08	0.27
	August	0.09	0.28	0.08	0.27
	September	0.09	0.29	0.09	0.28
	October	0.09 ^D	0.28	0.10 ^D	0.30
	November	0.09	0.28	0.09	0.29
	December	0.08	0.28	0.08	0.27
Level of education of the father	Did not go to school	0.01	0.09	0.01	0.09
	Did not finish compulsory education	0.15 ^D	0.36	0.19 ^D	0.39
	Compulsory education	0.26	0.44	0.28	0.45
	High school or medium professional track	0.25	0.43	0.28	0.45
	High professional track	0.12 ^D	0.33	0.10 ^D	0.30
	3-year university degree	0.08	0.27	0.06	0.24
	4-year university degree	0.10 ^D	0.30	0.07 ^D	0.26
Level of education of the mother	Master	0.02	0.13	0.01	0.11
	PhD	0.01	0.09	0.00	0.06
	Did not go to school	0.00	0.06	0.01	0.08
	Did not finish compulsory education	0.10 ^D	0.30	0.16 ^D	0.37
	Compulsory education	0.22 ^D	0.41	0.27 ^D	0.44
	High school or medium professional track	0.25	0.43	0.28	0.45
	High professional track	0.15 ^D	0.36	0.11 ^D	0.32
Occupation of the father	3-year university degree	0.12 ^D	0.32	0.07 ^D	0.26
	4-year university degree	0.13 ^D	0.33	0.08 ^D	0.28
	Master	0.02	0.15	0.02	0.13
	PhD	0.01	0.08	0.00	0.07
	Never had a job	0.00	0.07	0.01	0.10
	Non-specialised worker	0.11 ^D	0.30	0.12 ^D	0.33
	Specialised worker of artisan	0.08	0.27	0.08	0.27
Occupation of the mother	Specialised worker in agriculture, ranching or fishing	0.04	0.20	0.04	0.19
	Machinery operator in factory or garage	0.08	0.27	0.07	0.25
	Services worker in hotels and shops	0.15	0.36	0.17	0.38
	Personal services worker, protection and security	0.06	0.23	0.05	0.22
	Owner of a little business	0.09	0.29	0.10	0.30
	Administrative	0.06	0.23	0.05	0.21
	Technicians or helps	0.09	0.29	0.10	0.30
	Manager or high civil servant	0.06	0.24	0.05	0.22
	Professionals	0.18	0.38	0.16	0.37
	Never had a job	0.03	0.16	0.04	0.20
	Non-specialised worker	0.14 ^D	0.34	0.17 ^D	0.37
	Specialised worker of artisan	0.05	0.23	0.05	0.23
Number of books at home	Specialised worker in agriculture, ranching or fishing	0.02	0.14	0.03	0.17
	Machinery operator in factory or garage	0.01	0.07	0.01	0.09
	Services worker in hotels and shops	0.21	0.41	0.23	0.42
	Personal services worker, protection and security	0.03	0.17	0.04	0.20
	Owner of a little business	0.05 ^D	0.22	0.08 ^D	0.27
	Administrative	0.19 ^D	0.40	0.16 ^D	0.37
	Technicians or helps	0.08	0.27	0.07	0.26
	Manager or high civil servant	0.05 ^D	0.21	0.02 ^D	0.15
	Professionals	0.14 ^D	0.35	0.10 ^D	0.31
	0 to 10 books	0.15 ^D	0.36	0.21 ^D	0.41
	11 to 50	0.40	0.49	0.42	0.49
	51 to 100	0.24 ^D	0.43	0.19 ^D	0.39
Region	101 to 200	0.11	0.31	0.09	0.28
	More than 200	0.10	0.30	0.09	0.29
	Gran Canaria	0.40 ^D	0.49	0.42 ^D	0.49
School funding	Non-capitalina	0.14	0.34	0.13	0.33
	Tenerife	0.46	0.50	0.45	0.50
	Private	0.26 ^D	0.44	0.31 ^D	0.46
	Public	0.74 ^D	0.44	0.69 ^D	0.46

Notes: “S.d.” stands for “Standard deviation”. The “D” indicates that there are significant differences (at 5% or less) between the mean of the “Non-repeater population” column and the mean of the “Sample” column.

Source: Authors’ own calculations.

Table A2. The influence of kindergarten attendance on students' academic performance, 3rd grade, including repeaters

Variables	First stage	Reduced form	
		Reading	Mathematics
Attendance to kindergarten: yes (ref.: no)	-	1.018** (0.476)	1.199** (0.532)
Instrument: mother's labour situation in 3 rd grade (ref.: does not have and does not search for a job)			
Full time worker	0.079*** (0.027)	-	-
Part-time worker	0.066** (0.028)	-	-
Unemployed	0.028 (0.028)	-	-
Retired	0.044 (0.063)	-	-
Mother's labour situation in 3 rd grade. Missing flag	-0.027 (0.038)	-	-
Sex: female (ref.: male)	-0.002 (0.008)	0.252*** (0.017)	-0.058*** (0.020)
Sex. Missing flag	-	-	-
Immigrant status (ref.: native)			
First generation immigrant	-0.161*** (0.035)	-0.008 (0.123)	0.194 (0.146)
Second generation immigrant	-0.024 (0.019)	-0.015 (0.044)	0.023 (0.049)
Immigrant status. Missing flag	-0.059* (0.031)	-0.102 (0.183)	-0.235 (0.207)
Month of birth (ref.: December)			
January	0.182*** (0.020)	0.129 (0.093)	0.113 (0.103)
February	0.202*** (0.020)	0.081 (0.110)	0.083 (0.120)
March	0.180*** (0.020)	0.022 (0.103)	0.037 (0.112)
April	0.174*** (0.019)	0.034 (0.096)	0.021 (0.107)
May	0.186*** (0.019)	0.039 (0.095)	0.002 (0.106)
June	0.207*** (0.020)	-0.087 (0.110)	-0.040 (0.123)
July	0.165*** (0.020)	-0.013 (0.089)	-0.012 (0.099)
August	0.182*** (0.021)	-0.113 (0.093)	-0.089 (0.103)
September	0.029 (0.020)	0.055 (0.045)	0.099** (0.046)
October	0.023 (0.020)	0.000 (0.046)	0.081* (0.046)
November	0.010 (0.020)	-0.024 (0.042)	0.041 (0.045)
Month of birth. Missing flag	-	-	-
Level of education of the father (ref.: did not go to school)			
Did not finish compulsory education	-0.035 (0.049)	-0.051 (0.119)	0.094 (0.126)
Compulsory education	-0.036 (0.049)	0.037 (0.121)	0.143 (0.127)
High school or medium professional track	-0.017 (0.048)	0.072 (0.117)	0.202 (0.124)
High professional track	0.005 (0.049)	0.092 (0.119)	0.225* (0.127)
3-year university degree	-0.008 (0.050)	0.115 (0.124)	0.264** (0.131)
4-year university degree	0.002 (0.052)	0.191 (0.126)	0.309** (0.130)
Master	-0.012 (0.057)	0.192 (0.138)	0.188 (0.143)
PhD	0.034 (0.067)	0.049 (0.164)	-0.055 (0.171)
Level of education of the father. Missing flag	-0.009	-0.193	-0.008

	(0.049)	(0.131)	(0.131)
Level of education of the mother (ref.: did not go to school)			
Did not finish compulsory education	-0.012 (0.070)	0.076 (0.145)	-0.052 (0.181)
Compulsory education	0.004 (0.069)	0.178 (0.144)	0.073 (0.183)
High school or medium professional track	0.038 (0.067)	0.240 (0.160)	0.091 (0.198)
High professional track	0.057 (0.068)	0.231 (0.160)	0.094 (0.197)
3-year university degree	0.072 (0.069)	0.333** (0.165)	0.155 (0.204)
4-year university degree	0.095 (0.069)	0.315* (0.169)	0.232 (0.206)
Master	0.090 (0.074)	0.267 (0.173)	0.349* (0.209)
PhD	0.187** (0.074)	0.325 (0.206)	0.338 (0.259)
Level of education of the mother. Missing flag	0.058 (0.072)	0.049 (0.318)	-0.192 (0.372)
Occupation of the father (ref.: never had a job)			
Non-specialised worker	0.018 (0.078)	0.069 (0.173)	-0.166 (0.179)
Specialised worker of artisan	0.032 (0.077)	0.064 (0.174)	-0.160 (0.177)
Specialised worker in agriculture, ranching or fishing	0.022 (0.081)	0.024 (0.175)	-0.156 (0.182)
Machinery operator in factory or garage	0.034 (0.077)	0.052 (0.173)	-0.197 (0.176)
Services worker in hotels and shops	0.025 (0.076)	0.088 (0.171)	-0.130 (0.173)
Personal services worker, protection and security	0.048 (0.078)	0.056 (0.171)	-0.211 (0.177)
Owner of a little business	0.090 (0.077)	0.047 (0.174)	-0.261 (0.179)
Administrative	0.057 (0.079)	0.178 (0.174)	-0.093 (0.179)
Technicians or helps	0.059 (0.077)	0.140 (0.173)	-0.128 (0.178)
Manager or high civil servant	0.069 (0.079)	0.111 (0.176)	-0.104 (0.181)
Professionals	0.042 (0.077)	0.115 (0.170)	-0.181 (0.175)
Occupation of the father. Missing flag	0.064 (0.076)	0.037 (0.171)	-0.239 (0.176)
Occupation of the mother (ref.: never had a job)			
Non-specialised worker	0.062* (0.033)	-0.040 (0.086)	-0.048 (0.090)
Specialised worker of artisan	0.102*** (0.036)	-0.013 (0.116)	-0.047 (0.127)
Specialised worker in agriculture, ranching or fishing	0.038 (0.047)	0.046 (0.109)	0.074 (0.118)
Machinery operator in factory or garage	0.075 (0.074)	-0.022 (0.182)	0.015 (0.191)
Services worker in hotels and shops	0.089*** (0.031)	-0.035 (0.095)	-0.041 (0.102)
Personal services worker, protection and security	0.160*** (0.040)	-0.088 (0.138)	-0.153 (0.149)
Owner of a little business	0.107*** (0.036)	-0.072 (0.109)	-0.057 (0.119)
Administrative	0.146*** (0.033)	-0.059 (0.110)	-0.067 (0.121)
Technicians or helps	0.144*** (0.035)	-0.115 (0.122)	-0.136 (0.138)
Manager or high civil servant	0.100*** (0.037)	-0.013 (0.121)	-0.018 (0.136)
Professionals	0.122*** (0.034)	-0.045 (0.109)	-0.077 (0.122)
Occupation of the mother. Missing flag	0.093*** (0.034)	-0.130 (0.106)	-0.137 (0.120)
Number of books at home (ref.: 0 to 10 books)			
11 to 50	0.004 (0.014)	0.139*** (0.031)	0.097*** (0.035)
51 to 100	0.000	0.236***	0.190***

	(0.016)	(0.034)	(0.039)
101 to 200	-0.004	0.240***	0.182***
	(0.020)	(0.042)	(0.047)
More than 200	-0.000	0.287***	0.309***
	(0.020)	(0.045)	(0.047)
Number of books at home. Missing flag	-0.035	-0.856	-1.971
	(0.043)	(1.675)	(1.864)
Region (ref.: non-capitalina)			
Gran Canaria	0.013	0.077	0.149*
	(0.015)	(0.048)	(0.078)
Tenerife	-0.011	0.095*	0.262***
	(0.015)	(0.048)	(0.079)
Region. Missing flag	-	-	-
School funding (ref.: public)			
Private	0.120***	-0.049	0.004
	(0.013)	(0.075)	(0.092)
School funding. Missing flag	-	-	-
Constant	0.339***	-1.176***	-1.045***
	(0.102)	(0.273)	(0.299)
Observations	13,124	13,124	13,124
Stock and Yogo (2005) test of weak instruments	-	6.759***	6.759***
Wooldridge (1995) endogeneity test	-	2.135	2.684

Notes: Standard errors are in parenthesis and robust. It has been controlled by a variable that indicates that the information from the kindergarten variable was recovered from 6th grade data. The null hypothesis of the Stock and Yogo (2005) test of weak instruments is that the instrument is weak and the null hypothesis of the Wooldridge (1995) endogeneity test is that the endogenous variable is now exogenous.

Estimation method: Two-Stage Least Squares (2SLS). The instrument is mother's labour situation.

Dependent variable: First stage: Kindergarten attendance ("1" for "Yes" and "0" for "No"). Reduced form: Students' standardised scores in reading and mathematics.

Coefficient: *** significant at 1%, ** significant at 5%, * significant at 10%.

Source: Authors' own calculations.

Table A3. The influence of kindergarten attendance on students' academic performance, 6th grade, including repeaters

Variables	First stage	Reduced form	
		Reading	Mathematics
Attendance to kindergarten: yes (ref.: no)	-	0.036 (0.465)	0.907* (0.474)
Instrument: mother's labour situation in 3 rd grade (ref.: does not have and does not search for a job)			
Full time worker	0.080*** (0.027)	-	-
Part-time worker	0.068** (0.028)	-	-
Unemployed	0.029 (0.027)	-	-
Retired	0.043 (0.068)	-	-
Mother's labour situation in 3 rd grade. Missing flag	-0.025 (0.037)	-	-
Sex: female (ref.: male)	-0.002 (0.008)	0.285*** (0.019)	-0.059*** (0.020)
Sex. Missing flag	-	-	-
Immigrant status (ref.: native)			
First generation immigrant	-0.162*** (0.034)	-0.032 (0.109)	0.222* (0.120)
Second generation immigrant	-0.026 (0.019)	-0.005 (0.050)	0.030 (0.049)
Immigrant status. Missing flag	-0.059* (0.031)	0.030 (0.170)	-0.106 (0.196)
Month of birth (ref.: December)			
January	0.182*** (0.019)	0.207** (0.089)	0.008 (0.096)
February	0.201*** (0.020)	0.119 (0.101)	0.017 (0.110)
March	0.181*** (0.019)	0.120 (0.097)	-0.022 (0.104)
April	0.175*** (0.019)	0.150 (0.093)	-0.053 (0.100)
May	0.186*** (0.018)	0.144 (0.092)	-0.009 (0.096)
June	0.208*** (0.020)	0.074 (0.106)	-0.127 (0.114)
July	0.165*** (0.020)	0.041 (0.086)	-0.078 (0.089)
August	0.182*** (0.021)	-0.003 (0.092)	-0.168* (0.096)
September	0.030 (0.019)	0.046 (0.039)	0.010 (0.044)
October	0.022 (0.020)	0.033 (0.042)	0.029 (0.044)
November	0.011 (0.020)	-0.016 (0.040)	0.050 (0.042)
Month of birth. Missing flag	-	-	-
Level of education of the father (ref.: did not go to school)			
Did not finish compulsory education	-0.037 (0.050)	-0.011 (0.120)	-0.229* (0.131)
Compulsory education	-0.038 (0.049)	0.075 (0.120)	-0.125 (0.129)
High school or medium professional track	-0.018 (0.049)	0.133 (0.118)	-0.102 (0.128)
High professional track	0.005 (0.050)	0.203* (0.119)	-0.031 (0.130)
3-year university degree	-0.008 (0.051)	0.116 (0.123)	-0.006 (0.137)
4-year university degree	0.003 (0.052)	0.245** (0.124)	0.110 (0.134)
Master	-0.008 (0.059)	0.154 (0.150)	0.002 (0.159)
PhD	0.036 (0.067)	0.124 (0.160)	-0.106 (0.184)
Level of education of the father. Missing flag	-0.011	-0.053	-0.242*

	(0.049)	(0.124)	(0.134)
Level of education of the mother (ref.: did not go to school)			
Did not finish compulsory education	-0.009 (0.070)	-0.004 (0.147)	0.114 (0.175)
Compulsory education	0.006 (0.068)	-0.007 (0.148)	0.153 (0.172)
High school or medium professional track	0.041 (0.067)	0.063 (0.159)	0.194 (0.185)
High professional track	0.059 (0.067)	0.082 (0.160)	0.194 (0.183)
3-year university degree	0.075 (0.068)	0.178 (0.164)	0.291 (0.191)
4-year university degree	0.100 (0.069)	0.195 (0.166)	0.281 (0.191)
Master	0.089 (0.073)	0.142 (0.176)	0.403** (0.199)
PhD	0.186** (0.073)	0.560*** (0.217)	0.531** (0.255)
Level of education of the mother. Missing flag	0.060 (0.070)	0.136 (0.299)	0.029 (0.356)
Occupation of the father (ref.: never had a job)			
Non-specialised worker	0.020 (0.077)	-0.059 (0.161)	-0.133 (0.192)
Specialised worker of artisan	0.034 (0.076)	-0.011 (0.162)	-0.144 (0.198)
Specialised worker in agriculture, ranching or fishing	0.023 (0.081)	-0.109 (0.170)	-0.256 (0.199)
Machinery operator in factory or garage	0.037 (0.077)	0.014 (0.162)	-0.171 (0.199)
Services worker in hotels and shops	0.027 (0.076)	-0.016 (0.158)	-0.107 (0.193)
Personal services worker, protection and security	0.051 (0.078)	-0.040 (0.163)	-0.127 (0.201)
Owner of a little business	0.093 (0.077)	-0.084 (0.164)	-0.240 (0.200)
Administrative	0.060 (0.079)	0.053 (0.165)	-0.070 (0.197)
Technicians or helps	0.062 (0.078)	0.018 (0.164)	-0.103 (0.197)
Manager or high civil servant	0.071 (0.079)	0.024 (0.168)	-0.107 (0.202)
Professionals	0.044 (0.077)	-0.013 (0.162)	-0.122 (0.198)
Occupation of the father. Missing flag	0.065 (0.076)	0.005 (0.162)	-0.259 (0.195)
Occupation of the mother (ref.: never had a job)			
Non-specialised worker	0.061* (0.032)	-0.062 (0.079)	-0.103 (0.089)
Specialised worker of artisan	0.101*** (0.036)	0.024 (0.110)	-0.112 (0.121)
Specialised worker in agriculture, ranching or fishing	0.039 (0.047)	-0.200* (0.106)	-0.034 (0.114)
Machinery operator in factory or garage	0.073 (0.072)	0.067 (0.150)	-0.078 (0.206)
Services worker in hotels and shops	0.089*** (0.031)	-0.026 (0.088)	-0.104 (0.100)
Personal services worker, protection and security	0.160*** (0.039)	-0.045 (0.124)	-0.197 (0.144)
Owner of a little business	0.108*** (0.036)	0.016 (0.105)	-0.049 (0.121)
Administrative	0.145*** (0.033)	-0.046 (0.105)	-0.134 (0.114)
Technicians or helps	0.144*** (0.035)	-0.083 (0.116)	-0.197 (0.126)
Manager or high civil servant	0.102*** (0.037)	-0.068 (0.120)	-0.082 (0.133)
Professionals	0.122*** (0.034)	-0.050 (0.104)	-0.139 (0.116)
Occupation of the mother. Missing flag	0.094*** (0.033)	-0.178* (0.101)	-0.195* (0.115)
Number of books at home (ref.: 0 to 10 books)			
11 to 50	0.004 (0.014)	0.108*** (0.031)	0.121*** (0.031)
51 to 100	-0.001	0.186***	0.219***

	(0.016)	(0.035)	(0.037)
101 to 200	-0.004	0.184***	0.194***
	(0.019)	(0.041)	(0.046)
More than 200	-0.001	0.307***	0.306***
	(0.019)	(0.043)	(0.043)
Number of books at home. Missing flag	-0.030	0.787	-0.774
	(0.042)	(1.494)	(1.741)
Region (ref.: non-capitalina)			
Gran Canaria	0.014	0.209***	-0.066
	(0.014)	(0.071)	(0.061)
Tenerife	-0.009	0.064	0.038
	(0.014)	(0.072)	(0.063)
Region. Missing flag	-	-	-
School funding (ref.: public)			
Private	0.113***	0.041	-0.016
	(0.012)	(0.085)	(0.078)
School funding. Missing flag	-	-	-
Constant	0.333***	-0.497*	-0.473
	(0.100)	(0.280)	(0.313)
Observations	13,124	13,124	13,124
Stock and Yogo (2005) test of weak instruments	-	7.164***	7.164***
Wooldridge (1995) endogeneity test	-	0.071	2.282

Notes: Standard errors are in parenthesis and robust. It has been controlled by a variable that indicates that the information from the kindergarten variable was recovered from 6th grade data. The null hypothesis of the Stock and Yogo (2005) test of weak instruments is that the instrument is weak and the null hypothesis of the Wooldridge (1995) endogeneity test is that the endogenous variable is now exogenous.

Estimation method: Two-Stage Least Squares (2SLS). The instrument is mother's labour situation.

Dependent variable: First stage: Kindergarten attendance ("1" for "Yes" and "0" for "No"). Reduced form: Students' standardised scores in reading and mathematics.

Coefficient: *** significant at 1%, ** significant at 5%, * significant at 10%.

Source: Authors' own calculations.