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The Effects of Number of Births on Educational Outcomes:

A Regional-Level Comparative Study of Peru

by

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Abstract

Learning attainments of children in Peru have remained at low levels according to international assessment. The country has carried out several educational policies from different perspectives aiming to raise the school achievements of students in primary and secondary education, nevertheless the levels of satisfactory attainments at the regional level show severe contrast between less and more competitive regions. This thesis aims to examine if the regional average number of births per woman has some influence on the regional level of satisfactory learning attainments of students in the 2nd grade of primary school, which means that they are fully prepared to undertake the following school grade. Satisfactory learning attainments are considered in this research as the main objectives within the educational progress, both in reading and mathematics skills. The study considers the percentage of students with satisfactory reading and mathematics levels as outcome variables, and regional average number of births, years of schooling, and age of women as explanatory variables; while it also includes a regional differentiation to assess whether the relationship between regional average number of births and learning achievements is stronger in less competitive regions or in more competitive ones. The major findings suggest that there is a statistically significant negative association between the average number of births at the regional level and the satisfactory learning attainments, with stronger effects in relation to children's reading skills. The regional average years of schooling of women showed a significant positive association with the reading attainments but not with the mathematics; whereas, the regional average age of women had a positive significant relationship with the reading and mathematics attainments. Lastly, the effects of the regional average number of births per woman were greater in less competitive regions for both subjects: reading and mathematics.

Keywords: educational, school enrolment, school attendance, learning attainments

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1 Introduction

1.1 Research Problem

Over the past few decades, the improvement of children's education in Peru has become an important matter of concern for public administrations and general population as well. Despite the severe political instability the country has faced especially over the past 5 years (Medina, 2021), public investment in education remained a priority and increased over the years. The total government expenditure on education reported as a share of the Gross Domestic Product (GDP) grew from 2.9% in 2010 to 3.8% in 2019 (The World Bank, 2020a). Similarly, the government expenditure per student expressed as a percentage of the GDP per capita, had significant increases between 2010 and 2018; at the primary level of education, it rose from 8.8% to 11.2% (The World Bank, 2020b) and from 10.6% to 14.6% at the secondary level (The World Bank, 2020c).

In addition to the sustained public spending on education, the Peruvian government has also implemented several policies aimed to raise the quality of education and thus increasing student learning outcomes. The National Intervention of Pedagogical Accompaniment has been an outstanding policy as it had nationwide coverage and showed positive effects on school performance at the primary and secondary education levels (Ministerio de Economía y Finanzas del Perú, n.d.; Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO), 2019; Rodríguez, Leyva & Hopkins, 2016). The purpose of this intervention was to improve the teaching skills and performance of teachers from public schools with the main objective of raising children's learning attainments, given that there is an undeniable link between teacher effectiveness and student learning (Stronge, Ward, Tucker & Hindman, 2007). Besides this, breakfast programmes were also provided at schools to encourage enrolment and attendance, proving to have positive effects in children's education (Cueto & Chinen, 2008).

Unfortunately, despite the increased education funding and the public interventions focused on different levels of education, the student learning attainments in Peru are low in comparison with other countries. In fact, the Programme for International Student Assessment (PISA), carried out by the Organisation for Economic Co-operation and Development (OECD), which measures the abilities of 15-year-old students in reading, mathematics, and science, shows that school students in Peru perform unsatisfactorily. As reported by the PISA 2018 results, the scores achieved in Peru are 401, 400, and 404 in reading, mathematics, and science, respectively; whereas the OECD average scores are 487, 489, and 489, correspondingly (OECD, 2021). Besides the fact that the Peruvian scores concerning the three school subjects are significantly below the OECD average, the results exhibit that Peru lags behind most of the countries evaluated by being placed in the position 64, amongst 77 countries, in the ranking sorted from the highest reading score to the lowest.

The Ministry of Education in Peru also conducts assessment tests periodically to measure the progress of students and reports results concerning the 2nd and 4th grades of primary school, as well as in the 2nd grade of secondary education. According to the latest results published by the Ministry, in 2019, students in 4th grade of primary school and 2nd grade of secondary education achieved higher learning attainments than in 2016, while the achievements of students in 2nd grade of primary school deteriorated in both mathematics and reading (Ministerio de Educación del Perú, 2021). In 2016, 25.2% and 11.5% of students in 4th grade of primary and 2nd grade of secondary education, respectively, achieved satisfactory mathematics levels; which improved considerably by rising to 34% and 17.7% in 2019. Similarly, in 2016, the proportion of students with satisfactory reading skills in the aforementioned school levels reached 31.4% and 14.3%, correspondingly, which grew to 34.5% and 14.5% in 2019. The reported results revealed that the percentage of students in 2nd grade of primary school with satisfactory learning level decreased between 2016 and 2019, dropping from 34.1% and 46.4% in mathematics and reading, respectively, to 17% and 37.6% accordingly. Furthermore, the results also showed that the level of students with satisfactory learning achievements differed greatly across the regions in the country, which could suggest that specific features or the levels of regional development may have some influence on how successfully students are receiving knowledge. The uneven educational progress between school levels and the extreme differences in satisfactory learning across regions signal an unstable educational development in Peru, with special concern in the low cognitive level of students in 2nd grade of primary school.

It is remarkable that the government in Peru intended from different perspectives to improve children's education, yet, due to the poor educational results, it is intriguing to explore if factors out of the scope of the public sector and schools may also be influencing the intellectual development of children. On the one hand, the quality of teachers is influenced to some extent by state interventions; nevertheless, their performance could also be affected by population changes caused by family formation and growth in fertility rates. On the other hand, it could be that interaction and motivation within the family household can influence the cognitive development of children; however, true behaviours are in fact difficult to capture and identify on a regular basis. Consequently, a more macro analysis considering family structures across regions could help to elaborate some thoughts about the relationship with educational outcomes.

In a recent study, Bruns and Luque (2015) analysed the conditions of teachers in Latin America and the Caribbean (LAC) and found that demographic changes could influence the quality of education. They claimed that especially in the southern part of LAC, the decline in the size of the school-age population could help improve the quality of teachers, since by requiring a smaller stock of teachers, their average salaries could have an increase and make the teaching profession more attractive to higher talented future educators. Moreover, the researchers argued that the reduction of student population would allow an effective pupil-teacher ratio to be maintained, which in turn could facilitate adequate class management to improve student learning achievements.

While a decline in the student population could benefit educational development perhaps by easing pressure on the school system, a study on how population development based on family size could also provide insight into a possible relationship between demographic factors and education. In a previous report, the United Nations (2004) pointed out that family size could have an impact on children's schooling. The analysis found that in some countries, unwanted

and excess fertility could diminish children's educational attainment. Furthermore, the National Research Council and Institute of Medicine (2005) claimed that even in developing countries in which average family size is decreasing, the number of siblings or co-residential siblings could have negative effects on the children's schooling attainments.

Intuitively, it could be argued that as the number of children in a household grows, the resources allocated on each child are likely to be reduced which could lead to negative implications on the investment made on their education. In this sense, parents from large families could possibly have to decide whether to make the major investments in one child or affect negatively the years of schooling of all their children. Restrictions on the family budget may be an influential factor in children's educational attainment; nevertheless, it could also be possible that big families choose to have several children because they are able to foresee good conditions for every child, either because of their wealth or because their regional context can satisfy children's educational needs. This study will, at the macro level, focus on the average structure of families, leaving the economic restrictions aside and examining what role fertility plays on children's learning outcomes in Peru. Also, for comparative purposes, a regional analysis will be developed to explore the effects on areas with different characteristics.

1.2 Aim and Scope

This research aims to explore the relationship between average regional number of children per woman and educational outcomes of children in the 2nd grade of primary school, given that their latest results have been adverse. With this purpose, the attempt will be to contribute to the demographic literature and to a better understanding of the educational development of children in Peru in two ways. First, the study will possibly shed some light on how influential childbearing patterns could have been to the current educational context in Peru, which might offer an opportunity to review and compare the regional educational progress and open further discussion. Second, research studies regarding births and education in Peru have mostly addressed this relationship going from the women's level of education to fertility (Cleland, n.d.; Tuman, Ayoub & Roth-Johnson, 2007), leaving a clear gap to study this association in the opposite direction, namely from the number of children to education, and thus provide new insights that could be taken into consideration for future public policies.

The main sources of information in Peru to gather data on school achievements and the number of births per woman are the Student Assessment Census (ECE) and the Demographic and Family Health Survey (ENDES). The compatibility between both sources is therefore essential to carry out this study, and they must both be used with the same level of aggregation. Although ENDES provides individual-level data, ECE is only made accessible on a regional level. Therefore, even if individual-level would be best suited for the proposed research, all variables in this study will be considered in the form of regional averages.

This thesis will deal with the influence of the average number of births on children's learning outcomes at a regional level. Despite several different aspects are often associated with the development of cognitive skills during childhood, the study will focus on the effects caused by

the regional average number of children per woman and, therefore, economic constraints and other factors within schools and households are beyond the scope of this study.

Consequently, the research will be guided by the following questions:

- Does the regional average number of births per woman influence children's learning attainments in Peru?

- If there is a significant association between the regional average number of births per woman and children's learning attainments, are the effects greater in less competitive regions than in more competitive ones?

1.3 Outline of the Thesis

In the first section of this thesis, the topic under study has been introduced, as well as the research motivation and the expected contribution. In the following section, background about the school system and the regions in Peru will be presented. In the third section, the theoretical framework will put into perspective prominent ideas from different scholars regarding the effects of increasing children on educational development. Also, findings from previous research will provide insights about the association between children and educational progress. The fourth section presents the proposed hypotheses that will be tested in the study. The fifth section will describe the data used in the analysis and will discuss the strengths and limitations. Subsequently, in the sixth section, the type of research, methodology, and model will be explained. A seventh section will show and discuss the research findings. Finally, the last section is concerned with the main conclusions.

2 Background

2.1 Peruvian Educational System and Regional Enrolment and Attendance Rates

Since the study aims to focus on the students in the 2nd grade of primary education, it is important to specify where this level stands within the educational system in Peru. According to the National Curriculum published by the Ministry of Education in Peru (2017), basic education is the first stage within the educational system and its objective is the integral development of students as well as the improvement of their abilities to perform adequately and optimally in society. In this framework, Regular Basic Education (EBR) is defined as the modality that aims to provide schooling to children and adolescents who go timely through the educational process according to their physical, affective, and cognitive evolution, from the moment of birth.

As shown in Table 2.1 (Ministerio de Educación del Perú, 2017), the EBR consists of 3 levels: Pre-school, Primary, and Secondary; and 7 cycles. Educational levels are gradual periods that address specific student learning needs. Schooling cycles are units of time in which educational processes take place considering abilities development expectations (learning standards). This cycle arrangement provides teachers and students with time and flexibility to develop abilities, with each cycle encompassing specific groups of students divided into grade levels.

Table 2.1 Levels, cycles, and grades of Regular Basic Education

Regular Basic Education													
Levels	Pre-school		Primary						Secondary				
Cycles	I	II	III		IV		V		VI		VII		
Grades	ages 0-2	ages 3-5	1°	2°	3°	4°	5°	6°	1°	2°	3°	4°	5°

According to the Constitution of Peru (1993), pre-school, primary, and secondary education are compulsory for all children, and free of charge in public institutions. It is important to note that in order to enrol children in the 1st grade of primary school, it is only necessary to have attended the classroom of 5-year-old students of cycle II of the EBR (see Table 2.1). In public schools, it is not required to pay school enrolment and tuition fees. In the case of private schools, the authorized charges include a one-time entrance payment, school enrolment fee, and tuition (Ministerio de Educación del Perú, 2020). Having to pay fees and tuition could pose a threat to

investment in children's education in families with tighter economic constraints, which perhaps might lead parents to enrol their children mainly in public schools in an attempt to satisfy other needs within the family resource distribution. Nevertheless, this does not necessarily mean that children would underperform compared to students from private schools.

In the first section of this paper, specific emphasis was placed on the school performance of students in the 2nd grade of primary education. In this regard, Figure 2.1 (adapted from Ministerio de Educación del Perú, 2018) shows that the average learning attainments of children in 2nd grade of primary education from public schools have superseded those of private schools in terms of mathematics skills, and the gap between the high educational achievements in reading abilities of children in private schools and the lower attainments of those in public schools has been shrinking progressively over the years. It could be argued that public education for children in the 2nd grade of primary school is reaching similar results as education provided by private institutions. Furthermore, the learning achievements of students from private schools seem to be stagnated while the educational outcomes of public education are showing large improvements.

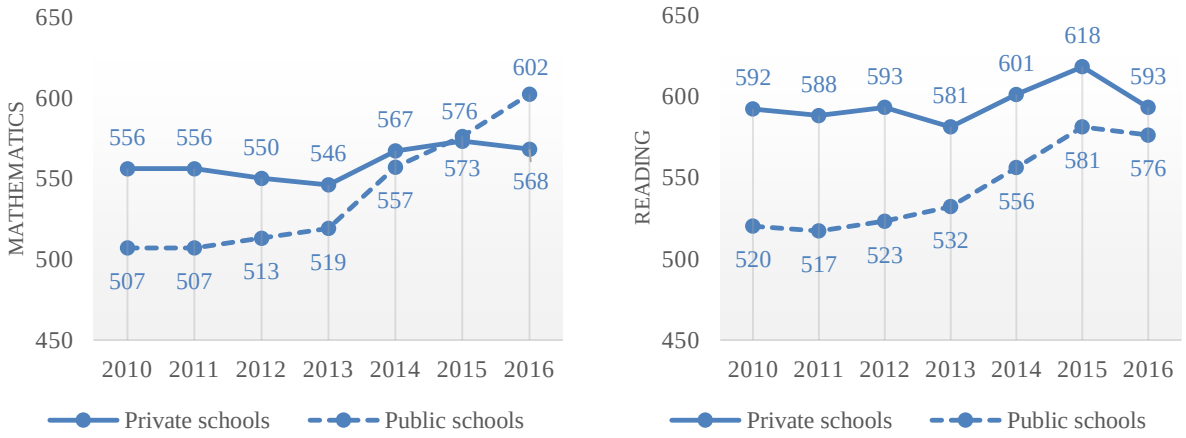

Figure 2.1 Average ECE scores of students in 2nd grade of primary education according to school type 2010 - 2016

It may be a good sign that high children's educational outcomes in the 2nd grade of primary education are not strictly dependent on whether education is provided by public or private institutions. However, considering that parental resources are commonly shared between the number of children being raised, even quality time spent with children at early ages can be seen as a declining parental resource. This is of high importance because parenting is a key determinant of human development and it helps build foundations on which children will then develop skills throughout life course (Francesconi & Heckman, 2016). In this sense, parental investment during the first years of life is crucial for the cognitive development of children. Furthermore, it could also be very important during the first school grades of children as they would benefit from parental support in adapting to new schedules and school work. In this sense, at the regional level, it could be that if families have on average a small number of children, this might possibly impact on their educational formation which could raise student intelligence to a satisfactory level.

The General Education Law (2003) in Peru establishes that education is a fundamental right of individuals and society, and that the State guarantees the exercise of the right to a comprehensive and good quality education. In addition, it is mentioned that pre-school and primary education are complemented with nutrition and health programs and the delivery of educational materials. This type of strategies implemented by the government may have probably influenced the high regional rates of school enrolment and attendance since basic needs such as having enough food and health care are primary necessities that can act as motivating factors, depending on the extent to which regions are able to meet the needs of children.

By 2019, more than 99% of children in Peru aged between 6 and 11 years were enrolled in the primary level of education (Ministerio de Educación del Perú, 2010a). Table 2.2 illustrates that some regions excelled as they reached 100% total enrolment rate in primary education early in time and for several years like in the case of Apurímac, Moquegua, Tacna and Tumbes. On the other hand, it can be seen that in 2019, Amazonas, Junín, Lima Metropolitan, Loreto, and Ucayali were the regions with the lowest primary school enrolment by having less than 99% of total enrolment rate. This measure does not show marked differences between regions but it is a first indicator of how primary education developed in Peru.

Table 2.2 Total enrolment rate in primary education (based on data from the Ministry of Education in Peru)

Regions	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Amazonas	98.5	98.6	98.4	99.8	99.6	99.4	98.9	98.0
Ancash	99.7	100.0	98.9	99.8	100.0	99.8	100.0	99.6
Apurímac	99.6	98.9	100.0	100.0	99.7	99.7	100.0	100.0
Arequipa	99.6	100.0	100.0	99.1	99.5	99.5	99.7	99.7
Ayacucho	99.7	99.7	99.2	99.9	99.6	100.0	99.3	99.4
Cajamarca	98.7	98.7	99.7	99.5	100.0	99.5	99.8	99.2
Callao	99.6	99.3	99.4	100.0	99.0	97.7	99.4	100.0
Cusco	99.3	99.7	98.5	99.2	99.8	99.3	99.7	99.8
Huancavelica	99.2	99.6	99.7	100.0	99.7	99.7	100.0	100.0
Huánuco	98.6	99.6	99.0	99.4	99.6	99.5	99.3	99.8
Ica	99.3	98.7	99.9	99.5	99.8	99.4	100.0	99.6
Junín	98.8	99.3	98.6	99.2	99.0	99.5	99.0	98.6
La Libertad	98.8	99.4	99.7	98.9	98.8	99.4	99.4	99.4
Lambayeque	99.6	99.8	98.9	98.9	99.5	99.8	99.5	100.0
Lima Metropolitan	98.8	99.0	99.3	98.4	99.1	99.8	99.8	97.9
Lima Provinces	99.1	99.7	100.0	99.9	99.9	98.9	99.4	99.4

Loreto	95.4	97.3	97.6	98.5	99.2	98.9	98.4	98.7
Madre de Dios	99.1	99.8	98.2	99.0	99.6	99.9	98.9	99.0
Moquegua	100.0	99.6	100.0	100.0	100.0	100.0	99.4	99.3
Pasco	98.4	98.4	99.8	100.0	100.0	99.4	99.3	100.0
Piura	98.3	99.8	99.4	99.5	98.9	99.0	99.6	99.6
Puno	100.0	99.2	99.3	99.7	98.7	100.0	99.8	99.7
San Martín	98.5	98.8	99.2	99.2	99.6	99.5	99.5	99.0
Tacna	100.0	99.6	100.0	99.7	100.0	100.0	100.0	99.9
Tumbes	100.0	99.2	100.0	100.0	100.0	100.0	100.0	100.0
Ucayali	96.5	94.4	95.9	96.0	97.3	98.0	98.1	98.5

Given that it could be argued that almost all children within the suitable age range are already enrolled in primary education, school attendance rates will take a deeper look into the regional educational context in Peru. Total attendance rates in 2019 showed that around 99% of enrolled students were attending primary school classes (Ministerio de Educación del Perú, 2010b). While Tacna and Moquegua are regions that achieved 100% of total attendance rate in primary education for more years compared to the others, in 18 regions of the 26 listed in Table 2.3, total primary school attendance rates did not reach the full coverage in any year between 2010 and 2019.

Table 2.3 Total attendance rate in primary education (based on data from the Ministry of Education in Peru)

Regions	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Amazonas	97.1	98.0	98.2	97.6	98.3	99.6	99.4	99.4	98.9	98.1
Ancash	99.5	99.4	96.0	99.8	98.8	99.6	100.0	99.4	99.6	99.6
Apurímac	99.0	99.5	91.3	98.9	99.7	98.6	99.7	99.7	99.6	99.6
Arequipa	98.6	98.7	99.1	100.0	100.0	99.2	99.1	99.5	99.7	99.5
Ayacucho	97.8	99.5	99.3	99.1	97.6	98.5	99.6	99.9	99.3	99.4
Cajamarca	97.9	98.1	98.7	98.1	99.4	99.2	99.6	99.0	99.8	98.9
Callao	99.5	99.6	98.5	99.6	98.8	96.9	98.1	97.2	97.4	99.0
Cusco	99.2	99.5	99.3	99.6	98.1	92.6	99.6	99.3	99.7	99.8
Huancavelica	100.0	98.8	99.2	99.6	99.1	98.9	99.5	99.7	100.0	100.0
Huánuco	96.8	97.8	96.9	99.1	98.2	98.7	99.0	99.5	99.4	99.8
Ica	98.6	99.2	98.8	98.4	99.1	99.6	99.8	99.2	99.6	99.6
Junín	97.8	98.9	98.6	99.1	98.2	97.7	98.3	99.5	98.6	98.2

La Libertad	98.1	98.1	98.1	99.3	99.5	96.2	98.2	98.3	99.3	99.4
Lambayeque	98.6	98.4	98.5	99.5	98.9	95.1	99.5	95.4	99.5	99.8
Lima Metropolitan	96.3	98.6	97.1	98.6	98.8	95.6	98.8	99.2	99.2	97.9
Lima Provinces	97.5	97.2	97.5	99.2	100.0	99.1	98.6	98.4	99.2	99.4
Loreto	93.3	89.1	87.9	96.6	97.6	97.0	98.1	98.0	98.3	98.3
Madre de Dios	98.4	99.0	97.9	99.6	96.7	97.5	99.6	99.6	98.5	98.9
Moquegua	100.0	99.2	100.0	99.6	100.0	98.6	99.2	100.0	99.4	99.3
Pasco	99.6	97.9	96.9	97.7	99.5	98.5	98.5	99.0	98.3	100.0
Piura	98.8	98.0	98.3	99.1	99.0	99.4	98.9	94.7	99.5	99.3
Puno	96.7	98.7	98.8	98.7	99.3	99.4	98.4	99.6	99.6	99.7
San Martín	99.7	98.2	95.8	98.9	97.8	97.3	99.0	98.7	98.6	98.7
Tacna	99.1	98.5	100.0	99.6	100.0	98.9	100.0	100.0	100.0	99.9
Tumbes	99.2	97.6	99.6	98.3	100.0	98.4	97.3	99.9	99.7	100.0
Ucayali	97.4	93.5	93.0	93.9	94.6	95.0	96.7	97.9	97.3	97.8

It can be seen that the almost all children in Peru have access to primary education and are attending school regularly. Also, the learning gap between 2nd grade students from public and private schools has been narrowing, which suggests that the learning outcomes at the regional level could currently be more balanced when considering both types of schools. The analysis at the regional level will therefore contemplate the student learning outcomes collected in all schools.

Considering that primary school enrolment and attendance rates are high in almost all regions in Peru, repetition rates will reveal more specific regional trends regarding the educational development of students in the 2nd grade of primary school. In fact, this measure could give a first idea about the learning progress of students.

In 2019, around 4% of students in the 2nd grade of primary schools in Peru repeated this school grade (Ministerio de Educación del Perú, 2010c). Table 2.4 shows that the repetition rates of students in the 2nd grade of primary school vary considerably among different regions. Considering the values from 2010 and 2019, Ayacucho, Huánuco, Amazonas, Apurímac, Huancavelica, and Loreto were regions that severely lowered their student repetition rates in 2nd grade of primary; however, by 2019, 3 of these regions (Huánuco, Amazonas, and Loreto) still had repetition rates among the highest percentages. It is, in fact, somewhat surprising that students in the first years of primary education repeat 2nd grade, since it could be assumed that educational tasks are not that difficult or complex at that life stage. Nevertheless, regional percentages show substantial contrast and there are some extreme differences between the values of the regions in 2019. For example, 9.1% and 7.8% of students in the 2nd grade of primary education in Loreto and Amazonas, respectively, repeated the school grade, whereas this indicator only reached 1.1% and 1.9% in Puno and Arequipa, correspondingly.

Table 2.4 Percentage of students enrolled in the 2nd grade of primary education who repeated (based on data from the Ministry of Education in Peru)

Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Amazonas	18.9	18.7	17.2	15.6	14.2	10.5	10.9	10.4	10.3	7.8
Ancash	15.0	12.7	11.3	12.5	11.6	7.7	7.0	6.5	7.4	6.0
Apurímac	14.2	12.6	11.3	11.9	9.9	7.0	5.5	4.8	4.2	3.5
Arequipa	4.1	4.1	3.8	4.0	3.4	2.3	1.9	1.7	2.2	1.9
Ayacucho	16.1	15.1	13.8	13.2	11.3	6.8	4.1	2.6	3.1	3.3
Cajamarca	15.7	14.2	14.7	14.3	13.5	9.3	7.8	7.5	7.8	6.1
Callao	4.9	4.2	3.6	4.9	4.0	3.3	3.7	3.7	4.2	4.3
Cusco	13.2	10.9	9.6	10.8	9.9	6.2	5.0	4.2	4.4	3.8
Huancavelica	15.3	14.5	13.8	15.8	14.4	9.2	5.8	6.0	6.1	4.6
Huánuco	18.8	18.1	16.4	16.1	15.8	11.4	9.3	8.4	9.2	6.4
Ica	6.3	5.6	4.8	5.2	5.5	4.5	3.3	3.7	4.5	3.6
Junín	9.8	9.7	8.8	9.3	8.3	5.7	5.7	5.8	6.1	4.7
La Libertad	11.8	10.8	9.8	10.4	9.2	7.1	6.6	6.0	6.3	5.5
Lambayeque	9.8	8.3	7.9	8.6	7.5	5.7	5.4	5.1	5.3	4.5
Lima Metropolitan	3.3	3.0	2.7	3.2	2.8	2.4	2.8	2.8	3.1	3.0
Lima Provinces	6.7	6.3	5.1	5.2	4.8	3.9	3.6	3.4	4.3	2.9
Loreto	19.4	18.5	20.8	21.2	18.4	15.7	14.8	12.7	15.7	9.1
Madre de Dios	8.8	7.4	4.1	6.2	5.7	6.5	5.4	4.6	4.5	3.1
Moquegua	4.5	4.8	2.9	4.3	3.1	3.1	2.4	2.8	2.7	3.3
Pasco	12.6	6.2	5.9	9.1	7.2	6.8	6.0	5.4	5.7	3.9
Piura	12.2	12.1	10.9	11.5	9.5	6.8	6.5	5.5	6.4	4.8
Puno	7.7	5.7	6.3	5.0	4.2	2.2	1.4	1.3	1.5	1.1
San Martín	13.8	12.2	12.1	12.6	10.8	8.2	6.6	6.1	6.7	4.7
Tacna	3.9	4.8	4.3	4.2	3.5	3.0	1.9	2.4	2.9	2.2
Tumbes	8.0	6.5	5.9	7.2	6.3	4.7	4.3	4.6	5.2	4.0
Ucayali	13.4	13.0	11.7	13.0	11.4	10.3	9.6	10.4	11.2	5.6

2.2 Regional Competitiveness Index

Throughout the years, regions in Peru have certainly developed but with certain differences between them. Beyond the usual differences between the urban and rural areas of living, regional conditions in Peru also differ in health, economic, and educational aspects, which could mean that average family structures may have been influenced differently by those circumstances. At the same time, these factors and their contrasting regional effects could also be indicators of how well children's needs are being met, particularly in terms of education.

In order to examine the different settings in Peru, the Regional Competitiveness Index (INCORE) provides a good general and comparative view of the regional economic and social progress with a unit of measurement that ranges from 0 to a value of 10. It calculates the regional dynamics and the relative difference between regions, using a methodology similar to that used by the World Economic Forum to estimate the Global Competitiveness Index (Instituto Peruano de Economía, 2021a), which will allow a regional inspection.

Table 2.5 shows the INCORE reported by the Peruvian Institute of Economics (IPE) (Instituto Peruano de Economía, 2021b) from 2010 to 2019 for all regions. In 2010, Apurímac, Cajamarca, and Huánuco had the lowest INCORE reaching only 2.8, 2.8, and 2.9, respectively. By 2019, the level of competitiveness of these regions grew but the increase was modest as their INCORE climbed just to 3.5, 3.2, and 3.2, accordingly. In contrast, in 2010, Arequipa, Ica, Lima (includes Lima Metropolitan and Callao), Madre de Dios, Moquegua, and Tacna achieved values above 5 (6.0, 5.8, 7.4, 5.2, 6.5, and 6.0, respectively), which suggests that they already had better conditions than the other regions 10 years ago. Surprisingly, the values in 2019 of the lowest performing regions at the beginning of the period analysed are considerably lower than those of the best performing ones in 2010. This clearly shows that some regions lag further behind than others. The development of the regions who had the worst INCORE does not seem to have been sufficient to catch up with the others, which is worrying since the period studied is a decade long.

On the other hand, among the regions with the best INCORE in 2010, Madre de Dios did not see any improvement by 2019, and on the contrary, its value decreased from 5.2 to 5.0. Furthermore, the region of Huancavelica also saw its level of competitiveness worsen between 2010 and 2019, as its INCORE declined from 3.0 to 2.7. Lastly, Junín stagnated at a value of 4.1 during all this period, and the regions of Amazonas, Loreto, Pasco, Puno, and Ucayali raised their regional competitiveness by 2019 but in a very small extent achieving INCORE values of just 3.7, 3.5, 3.6, 3.4, and 3.8, respectively. The cases of these regions are striking because this implies that the regional economic and social characteristics have not seen any positive change in a decade and, therefore, the living conditions of population in these regions have probably either deteriorated or remained at very low levels.

Table 2.5 Regional Competitiveness Index 2010 - 2019 (based on data from the Peruvian Institute of Economics)

Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Amazonas	3.2	3.2	3.2	3.3	3.3	3.5	3.5	3.7	3.9	3.7
Áncash	3.8	4.0	4.3	4.8	4.5	4.6	4.3	4.5	4.3	4.4
Apurímac	2.8	2.8	3.0	3.4	3.3	3.6	3.5	3.3	3.7	3.5
Arequipa	6.0	6.3	6.5	6.4	6.2	6.4	6.4	6.4	6.9	6.8
Ayacucho	3.2	3.2	3.5	3.4	3.3	3.7	3.6	4.0	4.0	4.1
Cajamarca	2.8	2.8	3.4	3.5	2.9	3.3	3.3	3.1	3.1	3.2
Cusco	4.1	4.1	4.6	5.0	4.8	4.9	4.6	4.6	4.4	4.4
Huancavelica	3.0	2.9	3.2	3.2	3.2	3.2	3.2	3.1	3.0	2.7
Huánuco	2.9	2.8	3.5	3.6	3.5	3.7	3.6	3.6	3.5	3.2
Ica	5.8	5.6	6.1	6.1	5.9	5.9	6.0	5.8	5.9	6.0
Junín	4.1	4.0	4.3	4.3	4.1	4.2	4.5	4.3	4.4	4.1
La Libertad	4.3	4.2	4.7	4.8	4.6	4.9	4.9	5.0	5.0	5.0
Lambayeque	4.6	4.4	4.5	5.1	4.7	4.9	4.8	5.1	5.1	4.9
Lima Provinces	4.4	4.5	4.8	5.0	4.8	5.0	4.9	5.0	4.9	5.2
Lima	7.4	7.1	7.5	7.5	7.5	7.9	7.8	7.7	7.7	7.7
Loreto	3.2	3.5	3.3	3.4	3.2	3.7	3.5	3.2	3.2	3.5
Madre de Dios	5.2	5.3	5.3	5.5	5.4	5.2	4.7	4.7	4.9	5.0
Moquegua	6.5	6.4	6.4	6.8	6.5	6.7	6.6	6.7	6.6	6.6
Pasco	3.3	3.7	3.7	3.8	3.4	3.8	3.6	3.7	3.8	3.6
Piura	4.0	4.0	4.5	4.5	4.0	4.2	4.2	4.3	4.3	4.4
Puno	3.1	2.8	3.0	3.0	3.0	3.4	3.0	3.3	3.2	3.4
San Martín	3.8	4.4	4.1	4.4	4.0	4.2	4.0	4.2	4.3	4.3
Tacna	6.0	6.3	5.8	6.4	6.0	6.5	6.5	6.6	6.8	6.7
Tumbes	4.7	5.1	4.7	5.3	4.7	4.6	4.4	4.5	4.8	4.8
Ucayali	3.8	3.9	4.5	4.4	3.9	3.6	3.8	3.9	3.8	3.8

In Figure 2.2 (adapted from Instituto Peruano de Economía, 2021b), it can be seen how the Regional Competitiveness Index (INCORE) has changed in a 10-year period, from 2010 to 2019. As pointed out before, some regions have improved but others have worsened or remained in poor conditions. Nonetheless, there are some additional remarks to make. First,

low levels of competitiveness are spread throughout the country, in the north, centre and south. Also, taking into account the size of the regions, the smaller regions do not always seem to have better INCORE values; there is a contrast, for example, between Moquegua and Tacna with high levels of competitiveness, and Huancavelica and Apurímac staying with lower INCORE.

In addition, neighbouring regions like Arequipa, Cusco y Puno show that despite being located around the same area of the country, they are in different stages of competitiveness development. Furthermore, it seems that they have not developed at the same pace and it could even be argued that their levels achieved have not been influential between each other during the studied decade.

Lastly, comparing the INCORE outcomes from 2010 and 2019, Cajamarca, Huancavelica, and Huánuco seem to be important cases of worsening and sustained low regional competitiveness. While, on the contrary, Lima and Arequipa are regions with significant progress. All these regions contrast in terms of competitiveness, size, and geographical location, which suggest that there are regional differentials that could potentially have some implications in education.

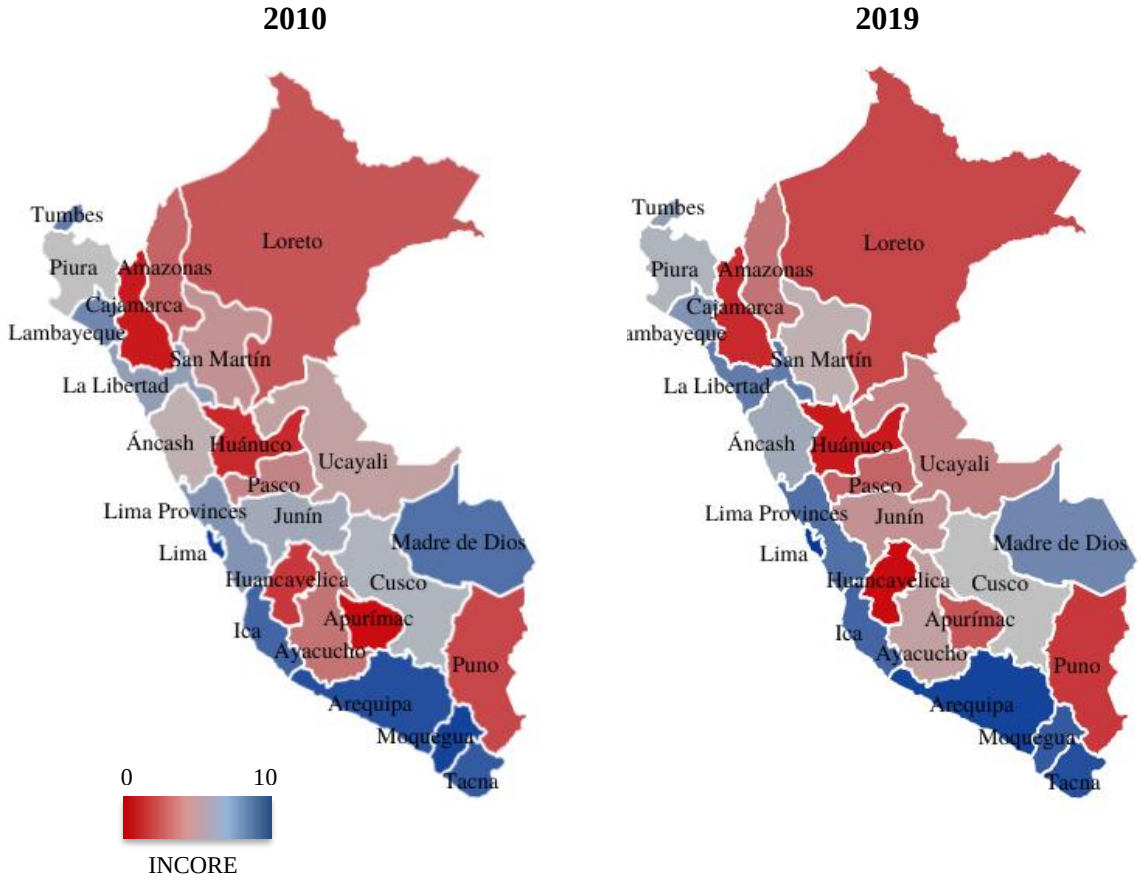

Figure 2.2 Regional Competitiveness Index in 2010 and 2019

3 Literature Review

This section will present theories and concepts about the negative influence of the number of children on intellectual development. The ideas behind this relationship will be developed taking into account the different aspects on which family formation processes take place, such as intellectual environment, parental resources, and investment in children. Furthermore, findings from past research will provide supporting evidence to guide the current study.

3.1 Theoretical Framework

Several researchers have studied the association between children's educational outcomes and family composition, interaction, and economic conditions. In relation to how influential family composition can be, Zajonc and Markus (1975) developed a confluence model in which they introduced the idea that an individuals' level of intelligence is affected by the intellectual environment within the family context. According to their view, the intellectual environment consists of the level of intelligence accumulated by parents and their children as they enter the family, averaged per member. The authors argued that, for example, in the case of a first-born child, the intellectual environment will consider the levels reached by the parents and a value of practically zero for the new-born, yet as the child grows and improves his/her skills, it will contribute to the intellectual environment that the next child will encounter. However, the model points out that as more children enter the family with a level of intelligence near zero, the average intellectual environment per member will have a depressing effect, therefore, the authors founded the belief that the intellectual environment decreases as the number of siblings increases.

The confluence model thus suggests that when the age gap between siblings is relatively short, the younger siblings will be the most affected by entering a declining family intellect, however, what is compelling is the fact that in general, all family members would face a shrinking intellectual environment anyways. This approach claims a clear negative relationship between an increasing number of siblings and the average level of intelligence they will be exposed in the households. Nevertheless, the parental level of education is not addressed and it even seems to be considered as constant throughout the periods of childbearing and upbringing of their children, which might not be totally compliant with the current parental perspective. It can be argued that nowadays more parents seek to nurture their knowledge along with the family formation processes and therefore could generate a growing family intellect. For this reason, including the educational level achieved by at least one of the parents will be relevant in this analysis.

The inverse relationship between a growing number of siblings and the children's educational achievements has been supported by many scholars, however, some of the explanations contrast in this regard. Besides the family configuration aspect and the importance of the collective level of intelligence, other factors within the family interaction are also involved with the youngsters' educational outcomes. According to the resource dilution theory proposed by Blake (1981), parents are only able to offer their children a determinate amount of resources such as material requirements (e.g. housing, basic life necessities, cultural objects), opportunities to develop abilities and skills, and attention that can lead children's learning progress; each of which is, therefore, diluted by and increasing number of siblings and consequently, the educational achievements of the children are reduced.

Downey (2001) supported the resource dilution theory and noticed that children are, in some way, competitors as they inevitably demand the same elements from the parents: financial resources, time, and care, so a small number of siblings is seen as more beneficial for children's educational growth opportunities. He developed further details regarding this theory and highlighted three key aspects. In the first place, he claims that parental resources are limited, despite potential improvement in incomes or job promotions that imply an increase in salaries; yet, he also foresees that parents could reallocate their budget arrangements from, for example, matters aligned to entertainment to others more related with educational progress to try to balance the increase in the number of children and the capacity to satisfy their learning needs.

The second contribution that Downey (2001) made regarding the impact of siblings is based on the extent to which parental resources can be shared among brothers and sisters, as well as the objectives to which the resources are directed. He mentions that some material resources such as books can be used to the same extent by all siblings, and therefore, the impact of a larger number of siblings on children's intellectual development will most likely not be as dramatic as if the parental resources were money savings for investment in a higher level of education. Furthermore, he proposes a resource differentiation and explains that base resources cover essential needs for the survival of children (e.g. appropriate clothing, shelter, and nutrition), while surplus resources are not crucial for subsistence but are used to increase long-term human capital (e.g. private classes, tutoring, improvement of study conditions and money saved for university). Thus, he suggests that in rich societies where children's basic needs are mostly met, the effect of additional siblings is likely to be stronger in allocating surplus resources; whereas, in low-income families, the effect of siblings on the resources destined to satisfy more complex educational needs will probably be negligible since their basic needs are possibly more demanding.

Lastly, Downey (2001) remarks that parental resources and investments are important for the development of children's intelligence but argues that their relevance lies in the life stage children are going through; for example, care would be most needed at younger ages, while university funding, at later stages of life. He further develops this idea and claims that the competition for resources between siblings persists throughout life given that although basic needs will not be so needed at later stages of life, elements such as gifts, loans and inheritances are likely to be desired by all siblings.

Although these theories were developed from micro-level data, they describe a clear inverse relationship between an increasing number of siblings and children's educational development.

The existence and influence of extended family members in households on the amount of resources to be distributed among children seems to be a neglected factor. It could be argued that other relatives beyond the nuclear family (parents and their children) living in the same household could help compensate low levels of parental intelligence or the lack of available resources offered to children, whether they are tangible or not; however, this probably will depend on their socioeconomic status which will not be part of this study.

In another major principle concerning children investment, Becker (1960) argued that children are seen by parents as goods that imply costs and returns, and claimed that parents deal with the decision of how many children to have, as well as how much investment to make in each of them. He mentioned that some types of investments that parents make in their children can involve providing better material conditions such as room improvements, extracurricular activities, and financing for higher education; and pointed out that children in whom the greatest investments are made, are considered as of high quality. Furthermore, his main argument establishes that the quantity and quality of children are closely related since the number of children would affect the amount of money and time that parents can spend on them. Moreover, he proposed that parents face a trade-off between the quantity and quality of their children, in which by having fewer births, the investments per child in raising the quality of their children can be greater than in the case of having a large number of children. Thus, this theory suggests that the number of children within families may restrict the investments made on each child, which could lead to the assumption that low investments in childhood education would produce low-quality children and possibly less successful educational achievements.

This research will take the main concepts of these theories regarding the negative influence of a larger number of children on their potential educational progress and scale them up to the regional level to examine if they can apply at that macro level. In this sense, the study will assess the effects of the regional average number of births on the satisfactory cognitive development of students and it will include a regional differentiation that would imply how differently children's needs are being met in their societies across regions to explore a possible gap in terms of the impact of the average number of children per woman on learning outcomes. This type of analysis agrees with the regional differences found concerning the learning achievements of students in Peru particularly at the 2nd grade of primary education, and also with the dramatic regional contrast that involves economic and social development.

These studies share the perspective that children's educational development can be affected by a growing number of children within the family. This research will intend to find evidence at a regional level to support or deny the negative influence of children on student intellect as suggested by the scholars in this field of study. In this sense, the availability of regional data regarding births and student learning attainments will be crucial to provide reasonable insight into the connection between the number of births and children's education. In addition, the regional contrast could make use of a broad feature encompassing several indicators of development to classify regions in an aggregate approach. An additional point of discussion will be the fact that education and fertility are factors that can be related to each other. The level of education achieved by women might be a determinant of birth rates, while an increasing number of siblings could affect children’s educational progress and, at the same time, parental education is expected to be a strong determinant of children's educational attainments as well.

3.2 Previous Research

3.2.1 Population Growth, Fertility and Education

Literature about population growth and fertility is extensive and has a long history. In a past research concerning educational development measured by adult literacy rate and school enrolment ratio, Liu (1967) found that those outcomes were associated to demographic factors. He concluded that countries more advanced educationally usually had lower birth rates, whereas in countries less advanced educationally, the birth rates were higher and tended to increase. Particularly in LAC, the difference between wanted fertility and actual fertility in less educated women can be twice as large as the gap among highly educated women (United Nations, 2004). While the level of education achieved in a country can be seen as a determinant for fertility rates, this study will analyse the relationship from a different perspective, aiming to identify the effects of births rates on the learning attainments of children.

Furthermore, Liu (1967) suggested that in order to achieve gains in education, literacy and educational expenditure, it would have been imperative for most of the less advantaged countries to reduce their annual birth rates to below 20 births per 1,000 people and their population growth rate to less than 1% per year. The previously stated guidelines were certainly not accomplished in Peru, as the birth rate remained over 20 births per 1,000 people until just around 2011 (Our World in Data, 2021a), and the population increased at a rate over 1.5% by the year 2018 (Our World in Data, 2021b).

There has been significant progress in terms of universal access and coverage of primary school in Peru. Nevertheless, it could be possible to find an association between a fertility measure as births rates and the educational outcomes, given that the decline in births rates was relatively slow in Peru, and the need for improved student learning attainments still remains in the country. The learning achievements of students are indicators that can show explicitly the impact of education on the acquisition of knowledge and cognitive abilities. For this reason, the focus of this study will be on examining school results, particularly those that reach a satisfactory level.

Nevertheless, the discussion about the effect of fertility on education has developed concerning the magnitude of the estimates. Simon and Pilarski (1979) claimed that population growth certainly influenced education negatively in countries with different levels of development, but they discussed that the effect was not as severe as noted before. In their analysis, they examined the effect of fertility on educational expenditure and school enrolment in less and more developed countries; and as a result, they revealed that fertility in less developed countries had a slight negative effect on educational expenditures per child, but no effect on primary and tertiary school enrolment rates. However, they found that the negative effect on secondary school enrolment was considerable. In particular, with regard to primary enrolment rates, it might be understandable that fertility was not as influential as the expansion of elementary education grew rapidly in all countries over the decades. Primary education in Peru has shown to have practically universal coverage, maintaining a total enrolment rate of around 99% in the last decade (Ministerio de Educación del Perú, 2010a); in this sense, studying the influence of

the regional average number of births in education on the basis of satisfactory learning achievements is a better outcome than school enrolment rates.

Foster and Yost (1969) also studied the relationship between fertility and education. Their study used a simulation model considering a time span of 30 years to analyse how population growth affects educational and economic development in Uganda. The researchers conclude that there is a clear inverse relationship between rural population growth rate and the per capita income growth rate. Moreover, they claim that this relationship is clearly associated with the inverse relationship between population growth rate and the educational level of children.

Even though the birth rates in Peru have been decreasing, teenage pregnancy continues to be an important issue. In a case study based on a cohort sample of Peruvian females aged 8 to 19 years, it was found that 21% of girls had a child and 22% were married or cohabitating by the age of 19 (Favara, Lavado & Sanchez, 2016). Early childbearing could impact on women's educational development by being a time-consuming responsibility and, perhaps most decisively, by increasing the economic restrictions limiting the investment in their own human capital formation. Moreover, it may also affect the transfer of knowledge that mothers could provide to their children in the early stages of life, given that young mothers probably have not yet accumulated a high level of intellect.

3.2.2 Family Size and Education

A study carried out by Belmont and Marolla (1973) showed the relation of birth order and family size with intellectual abilities. Their studied data consisted of almost 400 000 19-year-old men which represented practically all male survivors who were born in the Netherlands between 1944 and 1947, and to capture the intellectual performance of the individuals, their work used the results of the Raven Progressive Matrices with scores of 1 to 6, from high to low, respectively. As part of the findings, they found an inverse relationship between family size and the Raven scores, thus, the level of ability declined as families were larger. Furthermore, the score level declined as birth order position became greater.

In a past research carried out by Fort (1989) around three decades ago, he mentioned that despite past survey results showed that the ideal family size in Peru was 3 in those times, several factors encouraged women to have more children. Some of the factors he identified were high child mortality, the infrequent discussion about childbearing within marriage, cultural aspects regarding the importance of having children after marriage, and the negative connotation in relation to the use of contraception.

Several researchers have studied the relationship between family size and educational outcomes. According to Åslund & Grönqvist (2010), even though the effect found is not causal, they claimed that family size can affect grades in compulsory education. Furthermore, their findings revealed that the greater impact occurred among children with less favourable conditions like being part of a low-educated family. Thus, it can be said that the level of education of parents is likely to influence the learning achievements of children.

In a more recent study by Ponczek and Souza (2012), the negative relationship between family size and educational outcomes for boys and girls in Brazil became evident; moreover, the negative impact also affected human capital formation for young women. Besides this, the widespread cash transfers programs in developing countries have been part of the discussion as the potential incentive for higher fertility can be greater than the positive outcomes of the programs.

Theoretical framework proposes that there is a child quality-quantity trade-off within families, however, causality is still a very little developed subject. In a study developed by Black, Devereux and Salvanes (2005), with information from Norway, a negative correlation between family size and children's education was found, but the effects seemed negligible when considering birth order, for example. In contrast, they argued that stronger effects on educational achievements were associated to birth order.

3.2.3 Regional Differences

With evidence from a census from the mid-20th century, Stycos (1963) analysed regional fertility differentials in Peru. The author suggested that living in urban areas reduced motherhood especially after age 24, thus, a lower percentage of women was likely to become mothers in comparison to rural areas. Nonetheless, the findings also showed that urban residence was associated with higher birth rates. This examination also considered the cultural difference between Indian and Spanish-speaking regions, and the results showed that the latter were linked with higher fertility in both rural and urban areas. Consequently, motherhood and fertility appear to be influenced in different directions by urban-rural differentiation.

It is important to mention that fertility differentials in rural and urban areas may have changed in recent decades. For example, nowadays, cultural differences between regions might not be as sharp as before and population mobility due to employment or educational purposes could also have contributed to blurring some characteristics of rural and urban areas, and maybe even between regions. Also, the level of development in rural and urban areas may differ to different extents across regions. Therefore, the regional contrast in this study could be done at an aggregate regional level without diminishing the scope of exploring whether the effects of the number of siblings on children's educational attainments are the same in regions with comparable traits.

On the other hand, in Roach's (2009) work, the conclusions to which she arrived regarding children's education in Uganda are contrasting. She sustains that high fertility rates do not decrease educational attainment as much as expected. Her findings showed that when controlling for factors that also influence educational attainment, such as educational level and age of mothers and area residence (urban/rural), the effect of mothers' fertility is almost zero. In addition, she suggests that in order to help developing countries to raise their living standards in educational terms, the reduction of fertility is not the main answer. She points out that in Uganda there are other factors that do not help with increasing the educational attainment, such as regional differences in access to education and its quality itself, and families' incomes, among others.

Despite the different results to which studies concerning fertility and educational outcomes arrived at, the evidence still suggests that it is possible to find a relationship between the number of children and the learning outcomes of children in Peru. Also, the magnitude of the impact in this relationship could vary depending on the area of living and other regional conditions. This research will include additional variables accounting for maternal characteristics besides the regional average number of births, and also consider a comparison between regions with different features, mainly a different level of regional competitiveness index.

4 Hypotheses

The theoretical framework and previous research guide this study to undertake the scrutiny of the following hypotheses:

- Hypothesis 1: The regional average number of births per woman is negatively associated with the learning attainments of children in Peru.

- Hypothesis 2: The effects of the regional average number of births per woman are greater in less competitive regions than in more competitive ones.

5 Data

The Student Assessment Census (ECE) and the Demographic and Family Health Survey (ENDES) set out the basis for carrying out this study at the regional level. Since regional features will also be taken into consideration for comparative purposes, the Regional Competitiveness Index (INCORE) will provide a broad perspective of the regions in Peru allowing them to be classified according to their score. The period of time under study will encompass from 2010 to 2016 given that the availability of the required data is assured for that period as these are the years for which all three data sources are available.

In this sense, the current study will test if the number of births is associated with children's learning attainments at the regional level. In carrying out this research at the macro-level, a key concept is that the number of children will be estimated as the regional average number of births. Furthermore, it will be important to undertake the regional comparison with consistent aggregate data to examine whether the effects are truly different across regions depending on particular established features.

The analysis will consider 26 regions, encompassing the 24 regions and 1 constitutional province according to the political administration of Peru (Presidencia del Consejo de Ministros, 2017), plus Lima Metropolitan as it is the capital city of Peru and the most populated region (Municipalidad de Lima, n.d.). The case of Callao, which is the constitutional province, is special because it is located within Lima Metropolitan (Municipalidad Provincial del Callao, n.d.), nevertheless, this differentiation is important due to the fact that both regional authorities have autonomy and their demographic indicators are usually reported individually by some information sources.

Given that the regional student learning attainments in Peru contrast strongly and the impact of the number of births on children's educational development is expected to be different in societies with opposite characteristics, the regional comparison will be developed by using a particular feature across all regions. In this regard, the measure proposed in this research is the level of regional competitiveness because it involves different types of regional characteristics, which will allow an integrated approach to the study of the regions and will provide a unique distinction. The reason to choose this procedure instead of the urban-rural differentiation relies on the dissimilarities that these areas can hold among regions in Peru. To be specific, urban areas in some regions may be rather less developed than in other regions, and at the same time, the level of development in rural areas could differ substantially between regions. In section 5.1.3, a more detailed explanation will be given regarding the selected measure for the regional differentiation.

5.1 Data Sources

The Peruvian government has a long-standing history of collecting information from the population through surveys and censuses which, to a certain extent, guarantees adequate data credibility. This section will provide details about the sources of information, the chosen variables, and the restrictions, arrangements, or assumptions that were necessary to make when collecting the databases

5.1.1 Student Assessment Census

Over the past decades, the Ministry of Education (Minedu) in Peru has been conducting the Student Assessment Census (ECE) to analyse the students' learning progress mainly concerning reading and mathematics skills. This assessment takes place by the end of the school year, usually around the month of November. This source of information makes use of standardised tests and takes into account students from all public and private schools which allows a general overview of the educational conditions. The results from this source are accessible online and are representative for the school grade evaluated at the national and regional level, and according to the type of management (public/private) and area (urban/rural).

The study will focus on the educational outcomes of students in the 2nd grade of primary education due to 2 main reasons. First, because it represents the completion of one of the first schooling cycles, cycle III to be specific (see Table 2.1), and it is the first stage in which learning attainments are measured. Second, since the theories point at a negative relationship between the number of children and educational progress, the selected school stage will allow to test these concepts particularly at an early age such as 7 years. Also, this stage can provide information from all schools and for a long period of time. Results on the 4th grade of primary and the 2nd grade of secondary education can also be obtained from this census but data from these levels are only available for 2 and 4 years, respectively, which is considered as too short for this research.

According to the ECE results, the learning attainments of students are assessed using the following levels: at the start, in process and satisfactory. These levels illustrate what and to which extent students are learning with respect to the contents within the national educational curriculum; nonetheless, it is important to mention that the milestones that limit the scores between levels are defined by pedagogical specialists in the Minedu, in accordance with the national curriculum. Students assessed by the ECE accumulate points measured by the questions in the tests, and after that, their learning attainments are classified according to the levels. A brief explanation about the different learning levels can be found below.

- At the start: the student achieved very basic knowledge in terms of what is expected for the school level assessed.
- In process: the student partially achieved the knowledge expected for the school level assessed. Students are on the right learning track but still facing difficulties.

- Satisfactory: the student achieved the knowledge expected for the school level assessed and is ready to undertake the challenges of the next school level.

In this study, the outcome variable contemplated will be the percentage of students who reach the satisfactory level, since it shows the proportion of students that are successfully achieving knowledge and therefore have the appropriate abilities to get to higher educational levels. Furthermore, this research considers that achieving a satisfactory level of learning is highly important for students, since the acquisition of appropriate knowledge for their age would probably build strong cognitive foundations for their future development, which will probably, in the long-term, help improve the perspective of education in Peru.

Therefore, the selected variables considered as outcomes in this study are as follows:

- Percentage of students in the 2nd grade of primary school with satisfactory learning attainments in reading.
- Percentage of students in the 2nd grade of primary school with satisfactory learning attainments in mathematics.

5.1.2 Demographic and Family Health Survey

The National Institute of Statistics and Informatics (INEI) is the specialised technical public institution in Peru in charge of carrying out the official statistical activities. The purpose of the INEI is to produce and distribute high quality, timely and representative statistical information to contribute to the development of public policies and help decision-making processes (Instituto Nacional de Estadística e Informática, n.d.).

The Demographic and Family Health Survey (ENDES) is specially designed to collect information from women of reproductive age (15-49 years) and it is one of the most important statistical studies carried out by the INEI (Instituto Nacional de Estadística e Informática, 2018). The ENDES provides indicators associated with maternal and child health, contraceptive use and knowledge, reproductive and pregnancy information, diseases prevalence, among other demographic indicators. Data on women of reproductive age are accessible online and the results of this survey are representative at the national and regional level, and according to the area (urban/rural). The following modules were employed in the study:

- Module 66: Basic information from the women of reproductive age.
- Module 67: Births history.

Even if information from ENDES is available at an individual level, as mentioned before, the regional level is considered throughout the study as data from ECE is only accessible at the regional level. On the basis of the information drawn from the aforementioned modules, the following variables were calculated:

- Regional average number of births per woman.
- Regional average years of schooling of women.
- Regional average age of women.

The data collection process of this survey is carried out by properly trained personnel to develop inquiries professionally through personal interviews. As part of the protocol of the ENDES, it was required that both Module 66 and Module 67 were answered by women in reproductive age. Calculation of the regional averages was made considering that all variables had to match with the data availability of the women who answered the questions regarding childbearing.

5.1.3 Regional Level of Competitiveness

The Peruvian Institute of Economics (IPE) is a private institution whose purpose is to encourage the balanced and constant development of Peru based on improving the market economy; furthermore, the IPE aims to be the most influential private institution in terms of public policies by promoting discussion and possible solutions (Instituto Peruano de Economía, 2017). This institution calculates the Regional Competitiveness Index (INCORE) as part of its motivation to show the social and economic reality of the regions in Peru, which will allow in the current study to perform the regional differentiation and examine how different the regional average of births can affect student learning attainments.

Since 2010, the IPE has been assessing the level of competitiveness at the regional level taking into account various components. In this sense, the INCORE is calculated through 40 indicators grouped into 6 pillars: economic settings, infrastructure, health, education, employment, and institutions (Instituto Peruano de Economía, 2021c). According to the INCORE methodology, each indicator is assessed in a scale from 0 to 10, then the value for each pillar is measured by the average of the corresponding indicators, and finally, the index is the average value of the 6 pillars.

The INCORE can provide a global perspective regarding the conditions of all regions in Peru. By using a large number of indicators, this measure is not restricted to the regional economic aspect but outlines a more complete frame regarding the regional settings to carry out the regional differentiation analysis. Also, an important point is that this measure will comprehend information related to resources that can affect children's education from the parental angle, given that the pillars engaged with the calculation include education, economic settings, and employment, which could somewhat influence children's educational development within regions. This research will therefore make use of the INCORE to categorise the regions of Peru as more and less competitive bearing in mind that this measure is, in essence, broad.

To carry out the regional comparison, a binary variable will be created to classify regions according to their level of competitiveness and explore how strong the effects of the regional average of births on children's education can be across regions with different levels of competitiveness. This binary variable will be defined using the median of the INCORE values of the regions; and this median will be calculated independently for each year under study. Thus, the binary variable will take the following values:

- 1 when the INCORE is lower than the annual median value (less competitive region).
- 0 when the INCORE equals the annual median value and onwards (more competitive region).

5.2 Data Limitations

First of all, it was not possible to link the children's learning outcomes and the information about the number of children at the individual or province level, which is why averages were calculated and the study was carried out at the regional level. Having information at the individual level would have allowed to build a more direct connection between the number of births and the learning achievements of children within the same household, for example. This would be best suited for the current study as it would capture more accurately the effects between the chosen variables. In this sense, information at the regional level would not consider particular associations such as children with high educational outcomes within large families or, on the contrary, small families with underperforming children. Nonetheless, this study could be a first approach to the relationship between births and educational attainments, considering that these variables show different patterns across regions.

Regarding the Student Assessment Census, as it was mentioned before, the study focuses on the 2nd grade of primary education given that the student achievements showed an unstable progress throughout the years and across regions. Nevertheless, the possibility of extending the time series studied was not possible because the ECE was not executed in the year 2017 due to a Ministerial Resolution. Furthermore, the following year, the assessment census was made among students of 4th grade of primary and 2nd grade of secondary schooling. In 2019, the ECE was only conducted in the 2nd grade of secondary education, while an evaluation of students in the 2nd and 4th grade of primary school used a sample. Additionally, in 2010 and 2011, the level of coverage of the ECE in 3 regions (Ayacucho, Cajamarca, and Puno) did not meet the requirement to report results at the regional level, thus, those regions had missing values concerning the satisfactory learning attainments of the students in 2nd grade of primary school.

The Regional Competitiveness Index can vary over the years which allows for the possibility of having ups and downs. However, these variations were not drastic as shown in Figure 2.2; in general, each region followed its own trend and typical disparities between regions held relatively constant in the period of study.

On the other hand, a downside of the INCORE was that the index of Lima included Lima Metropolitan and Callao as a whole. Therefore, in order to be able to match the values with the variables reported by the other sources, the underlying assumption in this study was that the level of competitiveness of Lima Metropolitan and Callao was the same, given the fact that both regions are located practically in the same geographic space, thus, it could be assumed that their characteristics were identical.

Taking all data restrictions into consideration, the objective of measuring the effects of the regional average of births on children’s educational outcomes should be met by exploring the seven-year period. The assembled database contains annual information of all variables from 2010 to 2016 in 26 regions in Peru.

The study will not prove causality about the degree of influence of the regional number of births on the satisfactory student learning attainments, but the internal validity should provide

trustworthy remarks about the relationship between the explanatory variables and the educational outcomes of students in the 2nd grade of primary school.

On the contrary, applying the conclusions of this study in different educational settings would not be recommended given that, for example, the quality of education provided at schools was a factor outside the scope of this research; also, the assessment carried out by the ECE could be different compared to other educational systems.

6 Methodology

Given that the purpose is to identify and measure the effects of the relationship between the regional average number of births per woman and the satisfactory learning attainments of children in the 2nd grade of primary school, this thesis will use Ordinary Least Squares (OLS) regressions. This quantitative method will be developed using a stepwise strategy with multivariate models to see if the effects change when including explanatory variables and interaction terms. It will also use robust estimators to correct for heteroscedasticity.

This methodology is suitable because it can identify relationships between variables and can estimate the influence of explanatory variables. Also, the regressions will consider year fixed effects to capture the effects of the regional variations in the chosen variables and to prevent the outcome variable from being affected by variations caused by unexpected events in time. This study will be carried out at the regional level and over a 7-year time series, from 2010 to 2016. In this sense, a panel data considering observations from 26 regions in Peru will be employed which will allow to follow variables across regions throughout the time period. The proposed econometric model is the following:

$$Y_{it} = \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 D_{1it} + \beta_5 D_{1it} X_{1it} + T_i + u_{it}$$

Where:

Table 6.1 Description of the variables

Variables	Type	Description
Y_{it}	Continuous	Satisfactory reading/mathematics level
X_{1it}	Continuous	Regional average number of births per woman
X_{2it}	Continuous	Regional average years of schooling of women
X_{3it}	Continuous	Regional average age of women
D_{1it}	Binary	1 = Less competitive region 0 = More competitive region
$D_{1it}X_{1it}$		Interaction term
T_i	Time fixed effects component	Control for time-specific phenomena
u_{it}		Error term
i		Regions
t		Years

The outcome variable (Y_{it}) will account for the percentage of students in the 2nd grade of primary school with satisfactory learning attainments, and it will be used to measure, in 2 different models, the effects in reading and mathematics skills. This variable will show the proportion of students who successfully achieved the necessary knowledge and are ready to start the 3rd grade of primary school. The use of satisfactory learning attainments is therefore important because it will provide information on the extent to which students are prepared to take on more complex school subjects, which will probably signal educational progress in general. The econometric regressions will be run independently to assess reading and mathematics skills.

The regional average number of births per woman (X_{1it}) will represent the number of births that women of reproductive age had had on average, at the regional level, until the moment of the survey. In this study, this will be the main independent variable to test whether the number of children can influence satisfactory learning achievements in the 2nd grade of primary school. The hypotheses of this study will be tested by estimating the effects of this variable.

Regional average years of schooling of women (X_{2it}) will be the amount of education in years accumulated by women of reproductive age until the moment of the survey, at the regional level. Regional average age of women (X_{3it}) will depict the average age at which women of reproductive age were interviewed, at the regional level.

The binary variable (D_{1it}) will aim to identify the level of competitiveness of the regions in Peru over the period of study. This variable will use the following classification: "Less competitive regions" (1) and "More competitive regions" (0), defined by considering whether the region's INCORE score is below or above the median INCORE value for each year. This variable will allow to assess regional differences.

Additionally, $D_{1it}X_{1it}$ represents the interaction term introduced into the model in order to assess how differently the regional average number of births per woman impact on the learning attainments of children across regions categorised by their level of competitiveness. This term will be used to test if the effects of the regional number of births on educational outcomes vary according to the competitiveness classification of the region.

This research will examine what are the effects of the regional average number of births per woman on the satisfactory learning attainments of children, and to which extent these effects are different across regions with different level of competitiveness. An inverse relationship between the regional number of births and learning outcomes would be expected to be found, given their negative association suggested by the theories. In contrast, it is thought likely that years of schooling and age of women would have a positive influence on the satisfactory learning attainments of children. Also, as a type of robustness check, the models for reading and mathematics skills will also consider regressions that use more and less competitive regions independently.

7 Empirical Analysis

In this section, the data used in the research will be examined in a descriptive way to get a first impression of the regional information. Also, the findings from the regressions will be presented and discussed, bearing in mind what was expected from the literature review. Results regarding reading and mathematics skills will be reported separately.

7.1 Main Results

7.1.1 Descriptive Statistics and Bivariate Analysis

The descriptive statistical analysis of the data will allow a better understanding of the regional data and their characteristics, and help develop some initial thoughts about what could be found, which will then be tested using the aforementioned regressions. First of all, the panel data consisted of 182 observations and was found as strongly balanced, which indicated that the regional number of observations was consistent enough to carry out the study.

Histograms displayed in Appendix A of this paper show the frequency distribution of the variables under study. From these facts, it can be argued that while the frequency distribution of the satisfactory reading level seemed close to a symmetric one, the distribution of the satisfactory mathematics level was right skewed, meaning that the largest frequency of its values was mostly at low levels, between 5% and 25%. The distribution of the regional average of births per woman was close to a normal distribution with most values falling around the centre of the data, between 1.5 and 2.5 births per woman. The values of the regional average years of schooling of women showed a multimodal distribution in the dataset, having several peaks between 8 and 11 years of schooling. Finally, the regional average age of women depicted that the largest frequency of its values fell between the age of 30 and 31.

As can be reasonably expected, the level of satisfactory learning attainments differs across regions depending on how competitive they are. Figure 7.1 illustrates that more competitive regions have, generally, higher reading and mathematics achievements. One important observation regarding reading skills, is the fact that the lower quartile of the more competitive regions is almost at the same level as the upper quartile of less competitive ones, which suggests that around 75% of the satisfactory reading attainments in less competitive regions are below the 75% of achievements in more competitive ones. This depicts a big lag between students as most of the regional satisfactory reading attainments in less competitive regions are fairly behind their counterparts in more competitive ones. The difference, however, is less dramatic concerning the level of mathematics skills. In this regard, the satisfactory mathematics achievements in both more and less competitive regions fluctuate around more similar

percentages below 60%; nevertheless, the median value is higher in more competitive ones. It could be important to notice that Tacna was the outlier highly competitive region as it reached 64% of students in the 2nd grade of primary school with satisfactory learning attainments in mathematics in 2016.

Another important observation from Figure 7.1 is that the lower quartiles of the satisfactory mathematics attainments are below 20%, indistinctly of the level of regional competitiveness, which means that around half of the regional mathematics outcomes had less than 20% of students with satisfactory attainments. Furthermore, the percentages of students with satisfactory mathematics skills in less competitive regions are closer to 0%; particularly, the satisfactory mathematics level of the region of Loreto was less than 5% during the first 5 years of the period, showing that the vast majority of its students did not have the adequate mathematics skills to undertake the 3rd grade of primary education.

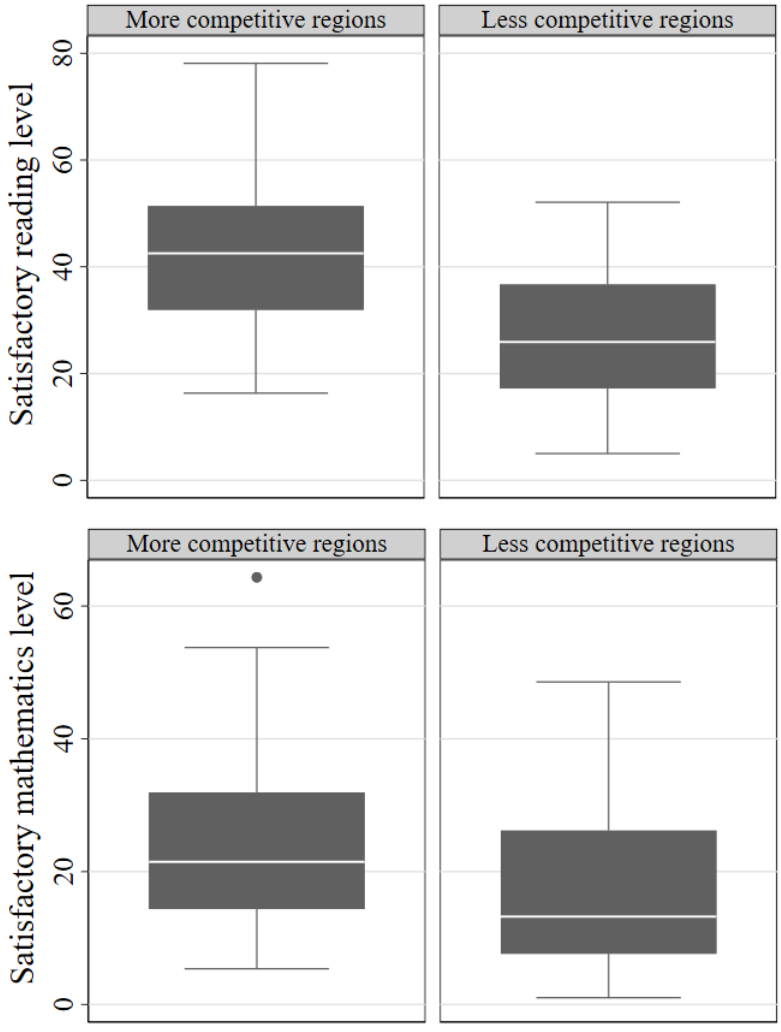

Figure 7.1 Distribution of satisfactory learning attainments according to regional competitiveness

Tables 7.1 and 7.2 present a group of summary statistics of regions with lower and higher levels of competitiveness, respectively. This information shows marked differences between regions, especially in terms of satisfactory reading and mathematics skills of students in the 2nd grade of primary school, average number of births, and average years of schooling.

In less competitive regions, 27% of students in the 2nd grade, on average, achieved satisfactory reading attainments, whereas, in more competitive ones, this percentage was greatly surpassed by reaching almost 43%. About mathematics achievements, 17% of the students in the 2nd grade of schools in less competitive regions had, on average, satisfactory attainments, while in more competitive ones, this mean percentage climbed to 24%. The percentage points gap between regions is by far larger regarding reading skills.

Concerning the number of births per woman, it can be said that women from less competitive regions had, on average, more than 2 children, which is certainly larger than the average amount of children that women in more competitive regions had, even if mean age at the time of survey was slightly higher in more competitive regions than in less competitive ones.

There is contrast also in terms of the average years of schooling of women, since the mean years of education attained are roughly 9 and 10, in less and more competitive regions, respectively. Also, the difference between the minimum average years of schooling of women in more competitive regions (7.86) is around one year more than those of less competitive ones (6.70). Lastly, the mean age of women is around 30 years, on average, whether they live in regions with better economic and social conditions or not.

Table 7.1 Summary statistics of less competitive regions

Variables	Mean	Standard deviation	Min.	Max.
Satisfactory reading level	27.31	12.35	5.02	52.09
Satisfactory mathematics level	17.09	11.42	1.02	48.56
Regional average number of births per woman	2.29	0.24	1.90	2.88
Regional average years of schooling of women	8.52	0.89	6.70	10.07
Regional average age of women	30.33	0.48	28.91	31.59

Table 7.2 Summary statistics of more competitive regions

Variables	Mean	Standard deviation	Min.	Max.
Satisfactory reading level	42.85	14.54	16.33	78.12
Satisfactory mathematics level	24.10	12.40	5.37	64.32
Regional average number of births per woman	1.77	0.25	1.30	2.41
Regional average years of schooling of women	10.36	0.92	7.86	11.61
Regional average age of women	30.69	0.56	29.32	32.70

As the analysis will focus on the relationship between the learning attainments of children and the regional number of births, Figure 7.2 will show some trends within the data with regard to reading and mathematics skills. In the following graphs, it can be seen that there is a negative relationship between the number of births at the regional level and satisfactory learning attainments both for reading and mathematics. Thus, as the regional number of births per woman increases, the satisfactory learning attainments decline. The relationship between these variables seems stronger in the case of the reading skills, given that the data points are closer to each other. Nevertheless, the correlation between the variables looks lower when dealing with satisfactory mathematics outcomes, since the data points are more dispersed. Although, the presented trends within the data could suggest that an increasing regional average number of children could negatively influence learning attainments, it is interesting that the relationship weakens when it comes to mathematics skills. In addition, Figure 7.2 also shows the regional contrast as the data points gather differently depending on the level of regional competitiveness.

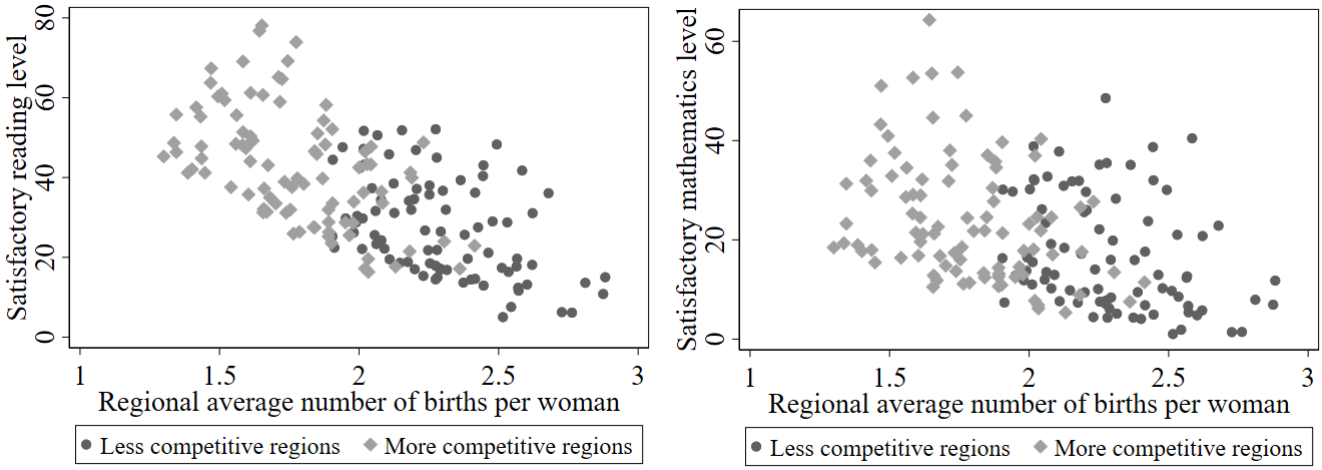

Figure 7.2 Correlation between satisfactory learning attainments and regional number of births

Besides this, apparent positive relationships were found between regional average years of schooling and age of women with the satisfactory learning levels of children in the 2nd grade of primary education (see Appendix B). According to the data, as the years of schooling of women increase, the satisfactory learning attainments also grow; nevertheless, the relationship is again weaker regarding mathematics skills. This could possibly be related to the fact that as women are better educated, they will probably be transferring knowledge more effectively to their children which would then be shown by the regional satisfactory learning achievements. On the other hand, the positive correlation between regional average age of women and satisfactory learning achievements is less clear. Nevertheless, in Appendix B it can be seen that most of the data points located at the highest levels of satisfactory learning attainments belong to regional averages from more competitive regions.

7.1.2 Multivariate Analysis of the Effects on Reading Skills

In order to test hypothesis 1 for reading skills, Table 7.3 shows that according to regression 1, the regional average number of births per woman was negatively associated with the satisfactory reading level, with a coefficient of -30.72. In this regression, as a first step, the average number of births was considered as the only explanatory variable in the model and it was found statistically significant with a 99% of confidence level.

In regression 2 (Table 7.3), years of schooling and age of women were included in the model as additional explanatory variables. An increased r-squared indicated that 85.9% of the variability of the satisfactory reading level could be explained by the 3 considered variables. By including women's educational level and age, the effects of the regional average number of births per woman attenuated but remained negative with a coefficient of -19.19, with a 99% of confidence level. This confirms hypothesis 1 for children's reading skills as the results suggest that an additional child in the regional average number of births per woman is associated with a 19.19% decrease of the satisfactory reading level.

Also, as expected, the regional average years of schooling of women demonstrated a positive relationship with the satisfactory reading level. The coefficient of this variable indicates that an additional year of schooling in the average for women at the regional level, is associated with an increase of 1.79% in the satisfactory attainments of children in reading skills. Similarly, for each additional year in the regional average age of women, the satisfactory reading level would be expected to increase in 8.89%.

Despite the attenuation of the negative influence of the regional average number of births on children's educational outcomes, illustrated in regression 1 and 2, hypothesis 1 was confirmed for reading skills. In this sense, it could be argued that an increasing regional average number of births, would be correlated with declining satisfactory reading levels of children in the 2nd grade of primary school.

Table 7.3 Regressions outputs of the base model for reading skills

Year Fixed Effects Regressions

Variables	**1**	**2**
Regional average number of births per woman	-30.72***	-19.19***
	(1.76)	(2.70)
Regional average years of schooling of women		1.79**
		(0.70)
Regional average age of women		8.89***
		(1.01)
Constant	88.82***	-221.83***
	(3.57)	(35.74)
Observations	177	177
R-squared	0.795	0.859

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Following the stepwise strategy, Table 7.4 displays findings from 4 different regressions to assess regional contrast in the relationship between the regional number of births and the educational outcomes, and thus, answer the second research question. Regression 3, which includes the binary variable for less competitive regions, confirms the negative relationship between the regional average number of births and satisfactory reading levels, with a coefficient of -19.99, which is similar to the one from regression 2. In relation to the regional average years of schooling and average age of women, these variables held the positive association with the satisfactory learning attainments in reading, with coefficients of 1.97 and 8.92, respectively. All these 3 explanatory variables were found statistically significant with 99% of confidence level. In this case, the associated effects of being less competitive regions were not found statically significant, which is why the following regressions will be useful.

In regression 4 (Table 7.4), the interaction term between the regional average number of births and the binary variable was introduced to assess if the effects are greater in less competitive regions, and was found statistically significant with 99% confidence level. The coefficient of births in more competitive regions was -26.73, meaning that an additional child in the regional average number of births is associated with a decrease in the satisfactory reading level of roughly 27%, which was statistically significant at a 99% confidence level. In the case of less competitive regions, the coefficient of births on reading outcomes remained negative but reduced to -14.87, which suggests that by increasing the regional average number of births in 1 child, then the satisfactory reading level would decline in approximately 15%, also statistically significant with a 99% confidence level.

In order to confirm or deny the results obtained when including the interaction term, regressions 5 and 6 (Table 7.4) show the coefficients of the 3 explanatory variables for less and more competitive regions, accordingly. In regression 5, the coefficient of the regional average

number of births per woman was -14.91, whereas in regression 6, it was -27.63. This supports the findings from regression 4 which suggest that the negative influence of births on educational outcomes is greater in more competitive regions. Furthermore, the coefficients of the regional average number of births in regressions 4, 5, and 6 agree around the same magnitudes.

In regressions 5 and 6 (Table 7.4), the regional average years of schooling of women confirmed a positive association with satisfactory reading levels but it was not found statistically significant. Lastly, the regional average age of women had coefficients of 8.71 and 8.85, respectively, which suggests that their positive effects on satisfactory reading levels were similar in all regions indistinctly of the level of competitiveness. According to the findings in regressions 4, 5, and 6, the impact of births seems greater in more competitive regions, not in less competitive ones. Thus, in terms of reading skills, the study fails to confirm hypothesis 2.

Table 7.4 Regressions outputs considering regional differentiation for reading skills

Year Fixed Effects Regressions

Variables	**3** Including binary variable	**4** Including interaction term	**5** Less competitive regions	**6** More competitive regions
Regional average years of schooling of women	1.97***	1.58**	1.41	1.49
	(0.71)	(0.71)	(0.89)	(1.25)
Regional average age of women	8.92***	8.68***	8.71***	8.85***
	(1.00)	(0.95)	(1.19)	(1.31)
Less competitive regions	1.30	-23.20***		
	(1.10)	(7.31)		
Regional average number of births per woman	-19.99***	-26.73***	-14.91***	-27.63***
	(2.86)	(3.50)	(3.45)	(4.81)
Less competitive regions*Average number of births per woman		11.86***		
		(3.60)		
Constant	-223.40***	-200.18***	-220.99***	-204.31***
	(35.39)	(34.25)	(40.38)	(45.65)
Observations	177	177	86	91
R-squared	0.860	0.868	0.827	0.832

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7.1.3 Multivariate Analysis of the Effects on Mathematics Skills

A similar procedure was carried out for the assessment of the satisfactory mathematics level of students in the 2nd grade of primary school. Results from regression 7, in Table 7.5, showed that the regional average number of births per woman had a negative influence on children's mathematics attainments with a coefficient of -15.92, statistically significant with 99% confidence level. This suggests that for any additional birth in the regional average, the percentage of students with satisfactory mathematics levels would decrease in almost 16%. When adding women's educational level and age (regression 8 in Table 7.5), the findings confirm the negative association between the regional average number of births and the satisfactory learning attainments in mathematics. The coefficient of average births indicates that for every additional child, the satisfactory mathematics level would be expected to decrease in approximately 11%. In both regressions 7 and 8 (see Table 7.5), this variable was statistically significant with 99% of confidence level, which allows to confirm hypothesis 1 for mathematics skills. It is notable that the effects of the average births attenuate more regarding reading skills (Table 7.3) than mathematics skills (Table 7.5) when average years of schooling and age of women are included in the models.

According to regression 8 (Table 7.5), the relationship between the regional average age of women and satisfactory mathematics levels remained positive with a coefficient of 8.28, meaning that an additional year in the average age of women, would increase the percentage of students with satisfactory mathematics attainments in around 8%, with a level of confidence of 99%. Conversely, the regional average years of schooling of women showed a negative association with the satisfactory mathematics levels, but the coefficient was very small (-0.16) and not statistically significant. In this model, 75.3% of the variability of the satisfactory mathematics outcomes was being explained by the 3 explanatory variables.

Table 7.5 Regressions outputs of the base model for mathematics skills

	Year Fixed Effects Regressions	
Variables	**7**	**8**
Regional average number of births per woman	-15.92***	-10.88***
	(1.83)	(2.61)
Regional average years of schooling of women		-0.16
		(0.65)
Regional average age of women		8.28***
		(1.10)
Constant	45.64***	-215.07***
	(3.76)	(37.19)
Observations	177	177
R-squared	0.670	0.753

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In order to assess hypothesis 2 for mathematics skills, Table 7.6 presents regressions considering different levels of regional competitiveness. In regression 9, it can be seen that the regional average number of births was negatively associated with the satisfactory mathematics level with a coefficient of -12.26, whereas the regional average age of women had a coefficient of 8.34, showing a positive association with the mathematics attainments. These variables were statistically significant with 99% of confidence level. The effects of the regional average years of schooling of women on mathematics attainments were very small and not statistically significant in any regression within Table 7.6.

Table 7.6 Regressions outputs considering regional differentiation for mathematics skills

Year Fixed Effects Regressions

Variables	**9** Including binary variable	**10** Including interaction term	**11** Less competitive regions	**12** More competitive regions
Regional average years of schooling of women	0.14	-0.14	-0.64	0.21
	(0.67)	(0.67)	(0.87)	(1.15)
Regional average age of women	8.34***	8.16***	7.42***	8.46***
	(1.10)	(1.08)	(1.44)	(1.56)
Less competitive regions	2.26**	-15.49**		
	(1.07)	(7.55)		
Regional average number of births per woman	-12.26***	-17.14***	-9.87***	-16.29***
	(2.72)	(3.43)	(3.49)	(4.85)
Less competitive regions*Average number of births per woman		8.59**		
		(3.67)		
Constant	-217.77***	-200.95***	-185.96***	-216.13***
	(37.14)	(36.58)	(48.05)	(50.62)
Observations	177	177	86	91
R-squared	0.757	0.763	0.765	0.730

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In regression 10 (Table 7.6), the negative effects of the regional average number of births, in more competitive regions, showed that by increasing the average births in 1 child, the satisfactory mathematics level would be reduced in 17%, statistically significant with 99% of confidence level. Whereas, in less competitive regions, the decrease in the satisfactory

mathematics levels would be roughly 9%. It is important to mention that the coefficient of the interaction term (8.59) was statistically significant with 95% of confidence level. The regional average age of women demonstrated a positive correlation with the satisfactory mathematics attainments with a coefficient of 8.16, statistically significant with 99% of confidence level.

Regressions 11 and 12 (see Table 7.6) present the coefficients of the explanatory variables considering only less competitive regions and more competitive ones, respectively. The coefficients of the regional average births in these regressions were -9.87 and -16.29, respectively, with a level of confidence of 99%. This indicates that the level of satisfactory mathematics attainments would decrease in approximately 10% and 16%, accordingly, when the average number of births increases in 1 child. These results show again that the negative effects of average births are greater in more competitive regions, not in less competitive ones, as it was expected. Thus, in terms of satisfactory mathematics skills, the study also fails to confirm hypothesis 2. Finally, the regional average age of women had again a positive association with the satisfactory mathematics levels with coefficients of 7.42 and 8.46, which are relatively similar to the ones in Table 7.4.

7.2 Discussion

According to the bivariate analysis (see Figure 7.2), a negative association between the regional average number of births and the learning attainments of children in the 2nd grade of primary school, was expected to be found. This correlation was clearer for reading skills given that regional observations showed a trend in which a higher average number of births was associated with lower satisfactory reading levels. Also, notably, the highest averages of births per woman belonged mainly to less competitive regions; and the lowest, to more competitive ones.

Data from regions with different levels of competitiveness support this pattern between births and educational outcomes. For example, considering the variables within the whole period of study, Tacna had on average 1.5 births per woman, and its percentage of students in the 2nd grade of primary school with satisfactory attainments in reading and mathematics was 62% and 43%, respectively. While, in contrast, Loreto had on average 2.6 births per woman, and just the 11% and 4% of its students achieved satisfactory reading and mathematics skills, correspondingly. Moquegua and Amazonas are regions with contrasting levels of competitiveness that could also illustrate this tendency, among many others.

On the other hand, the fact that the relationship shown in Figure 7.2 between the satisfactory mathematics level and the regional average number of births lacked clarity compared to the findings regarding reading skills, is something worthy of attention. Also, the regional satisfactory learning outcomes suggest that mathematics attainments are lagging behind the reading ones. It could be that satisfactory mathematics levels were partially a result of sustained high satisfactory reading levels, and thus they raise slower than reading attainments; nevertheless, it is still interesting to see that the influence of births could be different depending on the school subject.

As shown in Tables 7.3 and 7.5, there was a significant negative association (99% confidence level) between the regional average number of births per woman and the satisfactory learning attainments of students in the 2nd grade of primary education, which applied for both reading and mathematics skills, confirming hypothesis 1. In regression 2 and 8 (Tables 7.3 and 7.5), it can be seen that when controlling for factors such as years of schooling and age of women, the effects of the regional average number of births were particularly stronger regarding reading levels. These outputs indicate that when the regional average number of births increases in 1 child, the satisfactory reading level would decrease in 19%, while the impact on mathematics would be roughly 11%.

The regional average age of women was positively associated with the satisfactory reading and mathematics levels with a 99% of confidence level (see Tables 7.3 and 7.5). Conversely, the regional average years of schooling of women was only statistically significant for reading skills, as shown in Table 7.3, where it showed a positive relationship with satisfactory reading attainments. This lack of connection between the regional average years of schooling of women and satisfactory mathematics outcomes could also add to the idea that these achievements may be possible primarily after having accomplished high levels of satisfactory reading attainments, in spite of the level of education of women. Thus, it could be argued that the level of education of women may be more influential for satisfactory reading skills than for mathematics.

In terms of how different the effects of the regional average number of births were on the educational outcomes, the results differed from the statement of hypothesis 2. As shown in Tables 7.4 and 7.6, the negative influence of the average number of births was greater in more competitive regions than in less competitive ones. Perhaps, almost intuitively, one could think that any negative relationship would affect more in less competitive regions. However, in this case, it was proven wrong which led to denying hypothesis 2. The effects of an increase of 1 child in the average number of births in less competitive regions, were associated with approximately a 15% and 9% decrease in satisfactory reading and mathematics skills, respectively (see regressions 4 and 10). While in more competitive regions, the expected reductions in satisfactory reading and mathematics levels were 27% and 17%, correspondingly.

It might be that in more competitive regions, the effects of an increase in the average number of births on educational outcomes are greater because of what the competitiveness measure (INCORE) could imply itself. Perhaps, given that more competitive regions are likely to have better economic and social conditions, it could be that parental investment, in terms of time and assistance with children's tasks, may be affected due to the time dedicated to working which would negatively affect not the investment in children's education but the attention that can lead the learning progress. In this sense, time allocated to children or other patterns within parenting across regions could be a matter of further investigation.

Ideally, individual level data were best suited to examine the influence of the number of births on the learning outcomes. Nonetheless, it was possible to assess the relationship between these variables and it was confirmed at the regional level that the average number of births had negative effects on the satisfactory reading and mathematics attainments of children in the 2nd grade of primary school.

Despite this study was carried out at the regional level, another factor that might also play a role in the relationship between the regional average number of births and children's learning attainments could be the interval of time between births. The influence of this factor could be involved since the effects of the number of births could vary depending on the stage of life in which the children are. For example, if the birth spacing between children is small, it could be that parental assistance with school work might be carried out simultaneously. On the other hand, it is also possible that a large birth spacing between children could allow older brothers to perform as additional tutors for younger children. This could be something that may enlarge the scope of the analysis of the number of births and the influence on educational outcomes if performing a study at an individual level.

8 Conclusions

Based on the regional data, it became evident that there were different patterns in terms of the average number of births and children's learning attainments between more and less competitive regions. Generally, more competitive regions tended to have a lower average number of births per woman, and better performing students in the 2nd grade of primary education. The findings of this thesis confirmed hypothesis 1 (the regional average number of births per woman is negatively associated with the learning attainments of children in Peru) and denied hypothesis 2 (the effects of the regional average number of births per woman are greater in less competitive regions than in more competitive ones) for both reading and mathematics skills.

Considering that primary education in Peru is mandatory, free of charge in public schools, and enrolment and attendance rates are very close to universal coverage, the findings suggested that the regional average number of births per woman and the educational outcomes of children in the 2nd grade of primary school were negatively associated. The inverse relationship was stronger regarding satisfactory reading levels than mathematics, which could suggest that the latter might depend on the progress of the former or that other factors might cause that difference.

These results agreed with the concepts within the theoretical framework as they proposed that an increasing number of children would have negative effects on educational development. Given that this study was carried out examining the learning attainments of children at the early age of approximately 7 years, and school enrolment and attendance rates were high, it could be argued that in relation to the resource dilution theory, perhaps parental investment was more influential than the financial one. Also, the interval of time between births could help to test the confluence model if information were available at the individual level.

Finally, the parental investment could also be related to the fact that the effects of the regional average number of births per woman were greater in more competitive regions than in less competitive ones. This could be because more competitive regions are likely to have better employment settings which could possibly interfere with the quantity and quality of time that parents spend with their children, assuming that both parents work. Children at an early age might need more of the type of resources like parental support and attention rather than economic investment or material things to improve their satisfactory learning attainments; thus, parenting habits and practices could be further studied, at an individual level, to assess their influence on children.

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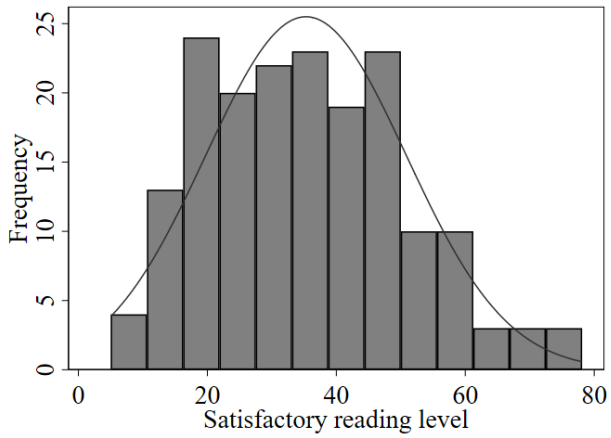
Appendix A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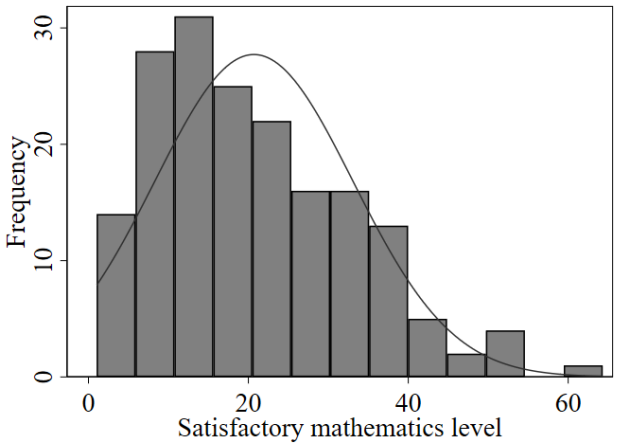
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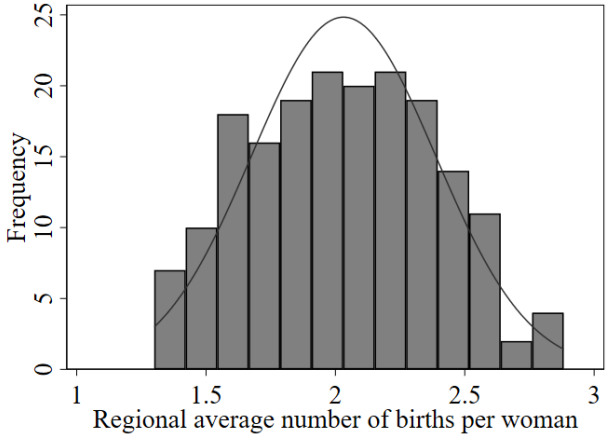
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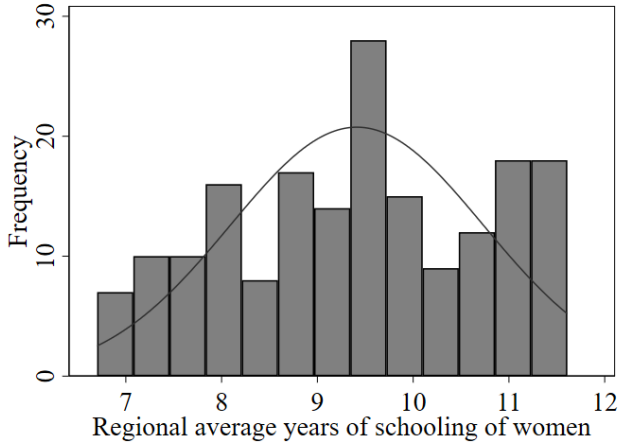
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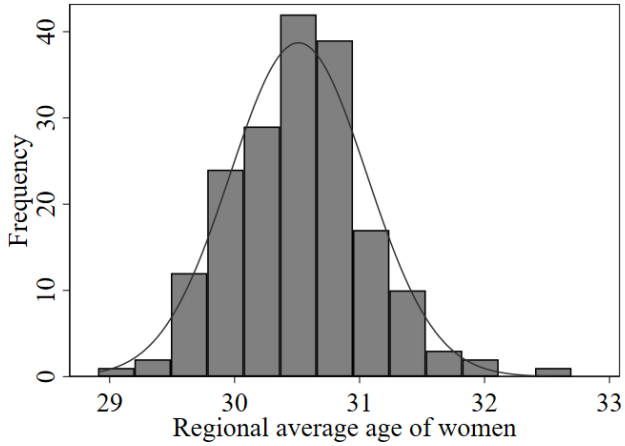
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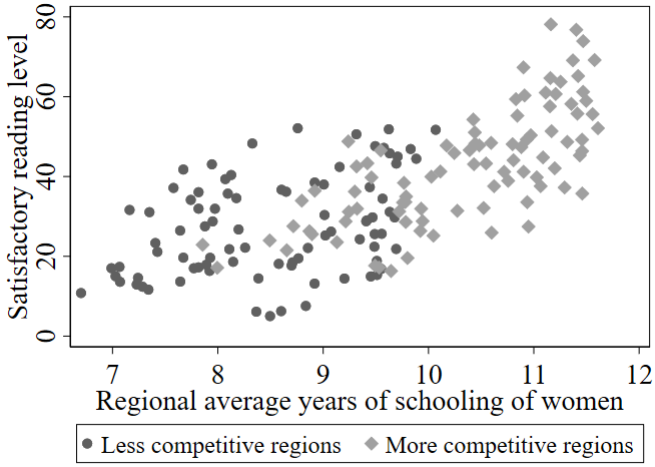
Regional average age of women

Appendix B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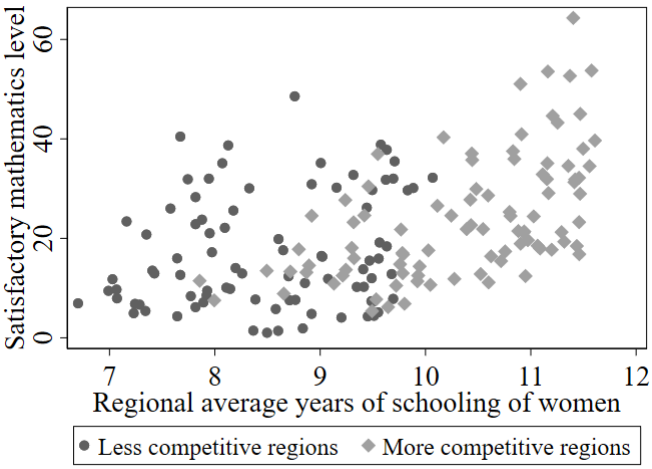
Regional average years of schooling of women
Less competitive regions
More competitive regions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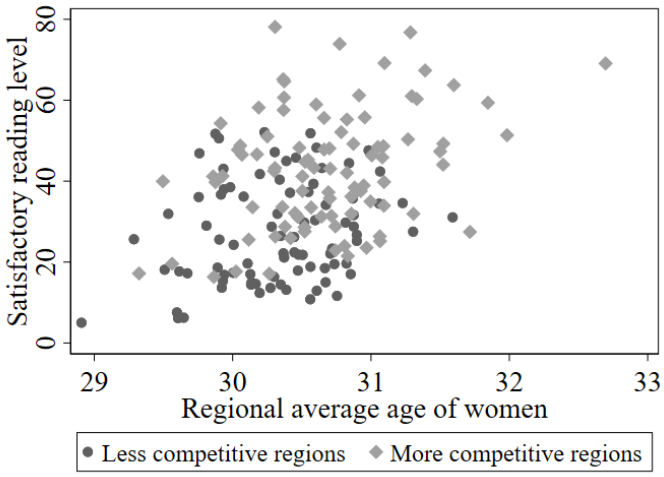
Regional average years of schooling of women
Less competitive regions
More competitive regions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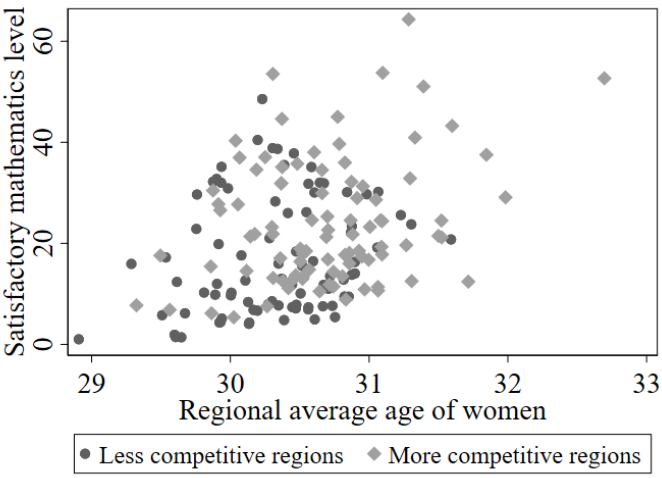
Regional average age of women
Less competitive regions
More competitive regions


Satisfactory mathematics level
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Regional average age of women
Less competitive regions
More competitive regions