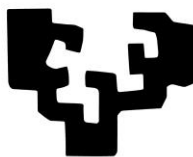


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Understanding segregation patterns in Chilean primary schools

Master in Economics: Empirical Applications and Policies
University of the Basque Country UPV/EHU
Academic Year 2022/2023

Author: Rodrigo Antonio Pérez Gatica.

Supervisors: Oihana Aristondo Etxeberria - Casilda Lasso de la Vega Martínez.



Bilbao, September 2023

Abstract

This study aims to achieve two primary objectives to comprehend segregation patterns in Chilean primary schools. To fulfill these goals, we compute the *school segregation index (SSI)* to assess the distribution of students from diverse socioeconomic and educational backgrounds across certain regions in Chile. The SSI provides a quantifiable measure of the concentration of students in specific schools, providing insights into the level of educational segregation. Additionally, we explore the factors influencing academic scores in 2019, using *Ordinary Least Square (OLS)* regression analysis, which allow us to comprehend how circumstantial and effort variables impact academic performance. The variables considered include income and average score, sourced from data available in *Sistema de Medición de la Calidad de Educación (SIMCE, 2013, 2019)*.

The results indicate that school segregation has decreased between 2013 and 2019, although some disparities still remain in the north of Chile. It is found no evidence of scores based segregation by schools, suggesting no significant relationship between academic achievement and school quality.

The *ordinary least square (OLS)* is conducted using average scores as a dependent variable in 2019. The results show that only 22% of the variation in scores can be explained by circumstances and effort variables. The primary factors influencing student achievement include their attitude towards future prospects, classroom distractions, and the type of school administration.

Keywords: School Segregation – SIMCE data – SSI index – Ordinary least squares (OLS)

Introduction

This thesis focusses on the Chilean education system; with a particular emphasis on the issue of school segregation, which has been a central concern driving various educational reforms. The objective of this study is to assess the impact of some of these reforms, specifically the ones implemented by *Michelle Bachelet Jeria*¹ in 2014. These reforms are particularly remembered for their aim to enhance access to education quality. Consequently, when discussing segregation, the debate usually centers on the tendency of students from certain socio-economic backgrounds to cluster in schools that share similar characteristics such as gender, ethnicity, income or achievement. The concentration of students based on specific characteristics has significant implications for educational opportunities, leading to significant disparities in educational performance, as highlighted

¹ Michelle Bachelet Jeria – Elected President of Chile on two occasions (2006-2010 and 2014-2018).

by *Treviño et al. (2016)*, they conclude that managing student diversity through segregation is a common practice in Chilean education system. Regarding the context of Chilean education, these issues have been always discussed and it basically tends to refer to the fact that there exist different contrasts between public and private school education. Public schools often struggle with infrastructure challenges and tend to concentrate students with socioeconomic disadvantage. In contrast, private schools are characterized by selecting students and have better infrastructure. In line with this perspective, *Gorard and Fitz (2000)* considers that this disparities are most likely due to social and demographic factors that perpetuate an unequal educational system, resulting for some regions manifesting a state of “equality of poverty”.

The aim of this study is to conduct an analysis that considers mainly school segregation based on income and achievement, the first specific goal is to calculate the SSI (School segregation index) as introduced by *Lasso de la Vega and Volij (2020)*. This index is used to examine segregation based on both income and academic achievements. By doing this, we are able to notice to what extent students with higher income assist to certain schools and lower income students assist to other type of schools, and secondly, to what extent the students with higher scores assist to certain school and vice versa. In section 2 we use data from school and family characteristics included in the SIMCE questionnaires for 2013 and 2019, in order to analyze the main impact done by the educational reforms implemented between these periods. The *SIMCE data*² categories students from primary schools along the country, though for simplicity we will use information from six regions concentrated in the north, center and south of Chile. After this process in section 3 we analyze the types of relationships that exist between school dimensions and the socio-economics characteristics of the students from families across the selected regions.

We argue that the efforts should not only focus on connecting the gap between the poorest and the wealthiest, due to the classroom performance have more significant impact on student’s achievements than income segregation. While the study does not find direct impacts of income segregation on academic scores, it highlights the importance of addressing academic segregation within classroom. Given the country’s vast geographical and demographic diversity, a uniform curriculum for all regions may not be ideal when far away regions and specially north’s regions show significant levels of segregation.

The main conclusions are outlined in section 4, where the study understands the favorable influence of parental socio-economic status on academic achievement. However, it

² All data used was provided by Agencia de Calidad de la Educación (2023). Cuestionarios de contexto y aplicación SIMCE 2013 y 2019 8.° básico. [Archivo de datos] Santiago de Chile. The authors thank Agencia de la Calidad de la Educación- Gobierno de Chile for providing the information.

highlights that the attitudes that students have is crucial toward the future of education and behavior within the classrooms, which can pursue a more robust influence on student's academic success. These factors, such distractions and expectations, deserve an important attention as they can significantly impact students' performance and learning outcomes. Moreover, while private schools have the ability to consider these factors within their classrooms, these disparities escalate significantly when it comes to public schools performance.

1. Chilean education system and evaluation

Chilean education has a primary education which is considered obligatory and last eight years starting in kindergarten up to eight grades, parents can choose among public, public-private and private depending on their socioeconomic status. Public schools are mainly financed by the government and administered by the elected major of the city, they are tuition free and anybody can access to them regardless their socioeconomic status. Public-private also known as "subencionados", they receive funding from the government based on attendance and they are required to follow same curriculum as ministry of education dictate, also they are allowed to charge tuition. However, it is important to mention that since 2017 in this type schools, the co-payment was gradually replaced by a contribution given by the government until the system is settled completely free of charge in the future, consequently the law requires both public and public-private to transfer school's administration to a new organization created for that aim. On the other hand, the privates are funded by tuition fees and student can access depending of the admissions and standards that the school provide.

In order to assess quality of education in Chile, the agency of quality takes SIMCE along the country every four years, and the test is administered to students along the country in grades 4 ,8 and 10, covering subjects such as language, arts, mathematics, science and social sciences. The test has a scoring range from 210 to 310 points across the country.

By conducting SIMCE, the educational ministry can keep track of students' progress over time and identify schools that might need improvement. Furthermore, the test results provide valuable information to parents, helping them make informed decisions about the quality of schools they choose for their children.

In this regards, *Meller (2019)* argues in order to improve Chilean education, the focus should not only be on whether the school is private or not, neither concentrate in equalizing the incomes between kids who go to public school to the ones who go to privates, because even the ones who belong to private school are not even close to the scores obtained by public schools that are part of OECD, as well as distance from the

privates that belong to OECD. The issue is more complex we it comes to compare the cost of education with OECD, Chilean private school pay over 30% more than the average of OECD schools, which it might tell us that student from Chilean private school end up paying 30% more for an education that could be consider ordinary.

2. Data and methods

As previously stated, data from SIMCE 2013 and 2019 is used, using information from students in eighth grades, as well as school and parents' questionnaires. In order to analyze properly the data we focus on six specific regions: Tarapacá, Antofagasta, Valparaiso, Metropolitana, La Araucanía and Bio-Bio. The sample is organized considering the differentiation between urban and rural areas due to the significant differences in educational opportunities that exist among these types of regions, such as: population size, city size and number of schools in each commune³. The aim of this subdivision is to provide a more accurate representation of the segregation between schools across the chosen regions. For instance, subdivision 0 comprises communes with a population from 300 to 20,000 inhabitants, categorizing them as "Small town". These small towns make up 7.3% of the total number of communes in Chile. Subdivision 1 includes communes with populations between 20,100 and 80,400 inhabitants, representing 12% of the total communes, classified as "Towns". Subdivision 2 considers communes with population ranging from 81,000 to 191,000 inhabitants, labeled as "City"; they represent 37% of the total communes. Finally, Subdivision 3 consist of communes with population between 200,000 and 574,000 inhabitants, classified as "Large city" and represent the 44% of the total communes, mostly concentrated in Metropolitan area.

These subdivisions offer a more comprehensive understanding of the educational situation in the selected regions. It allows addressing issues related to segregation and educational disparities between schools, taking into account the unique challenges and opportunities faced by school in different areas across the country.

The differences in income and achievement between schools that belong to different subdivision are captured in [Table 1](#). The variations in income and achievements are evident. Small towns and towns show an average income of 276⁴ CLP and 385 CLP in 2013 and 404 CLP and 544 CLP in 2019, respectively, amount which reflect minimal wage stated for those years. In contrast, city and large city have higher average income, with cities and large cities reaching an average of 738 CLP and 816 CLP in 2019 and 568 CLP and 641 CLP in 2013, respectively.

³ *Maríel et al. (2021)* utilized a similar classification, although this does not represent a methodology.

⁴ All monetary values are given in thousands of Chilean pesos (CLP)

As for achievements, city and Large cities have achieved higher scores, with 253 and 258 in 2019 and 264 and 270 points in 2013, respectively. This show little differences in regards to towns and small towns that have scored 241 and 248 points, respectively, in 2019, and 252 and 259 points, respectively, in 2013.

There are relative minor variances between small town and large cities in 2019, with a range of around 17 points, compared to the 18 points observed in 2013. This similarity is observed when clustering “towns” with “small towns” and “city” with “large city” due to their comparable characteristics.

Table 1. Distribution of students, income and achievements by type of city

Type of City	0	1	2	3	Total
2019					
Students	10,756	16,567	44,847	48,053	120,223
Percent	8.95%	13.78%	37.30%	39.97%	100%
Mean					
Income (CLP)	404	544	738	816	713
Achievement	241	248	253	258	253
2013					
Students	11,226	16,791	45,528	49,827	123,372
Percent	9.10%	13.61%	36.90%	40.39%	100%
Mean					
Income (CLP)	276	385	568	641	546
Achievement	252	259	264	270	264

Source: own elaboration with data from SIMCE.

Regarding educational schools, the number of surveyed students is divided in three categories of schools as described earlier: public, public-private and private. Each section of data provides information for two years, 2019 and 2013, enabling a comparison of information over time. [Table 2](#) presents data in a structured format for easy reference.

In 2019, for small towns, categorized as type 0, the table shows the number of student in public schools is 5,203, accounting for 5.43% of the total surveyed students in the country. In the same year, public-private schools had 3,094 students, representing 3.23% while private schools accounts for 0.04%. The total number of surveyed students in small towns is 8,336, making up 8.70% of the total students in the selected regions.

For towns type 1, in 2019, the data shows that public schools had 5,407 students (5.65%) and public-private had 7,056 students (7.37%), and private schools had 717 students (0.75%). Total number of students in towns is 13,180, accounting for 13.77% of the regions. Regarding 2013, it can be seen it is very similar for both type of city, with a slight increase in the percentage of students attending to public-private schools and private.

In the case of larger communities, cities categorized as type 2, in 2019 had 10,430 students in public schools (10.89%), 20,690 students in public –private schools (21.61%) and 4,643 students in private schools (4.85%). The total number of surveyed students in cities is 35,763, accounting for 37.35% in regions. In 2013 the data shows that cities had 15,193 students in public schools (12.31%), 26,243 students in public-private schools (21.27%), and 4,092 students in private schools (3.32%). The total number of surveyed students in cities in 2013 was 45,528, accounting for 36.90% of the total surveyed students in the selected regions.

Finally, large cities type 3 in 2019 had 10,223 students in public schools (10.68%), 22,722 students in public-private schools (23.73%), and 5,527 students in private schools (5.77%). Total number of students in large cities was 38,472, accounting for 40.38% of the total surveyed students. In 2013, larges cities had 15,770 students in public schools (12.78%), 28,243 students in public-private schools (23.28%), and 5,331 students in private schools (4.32%). The total number of surveyed students in large cities in 2013 is 49,344 accounting for 40.38% of the total selected regions.

Table 2. Number of surveyed students

Type of School	Small Towns		Town	
	Nro. Student	%	Nro. Student	%
	0		1	
2019				
Public	5,203	5.43%	5,407	5.65%
P-P school	3,094	3.23%	7,056	7.37%
Private	39	0.04%	717	0.75%
Total	8,336	8.70%	13,180	13.77%
2013				
Public	7,320	5.9%	7,731	6.3%
P-P school	3,840	3.1%	8,553	6.9%
Private	66	0.1%	507	0.4%
Total	11,226	9.1%	16,791	13.6%
Type of School	Cities		Large Cities	
	Nro. Student	%	Nro. Student	%
	2		3	
2019				
Public	10,430	10.89%	10,223	10.68%
P-P school	20,690	21.61%	22,722	23.73%
Private	4,643	4.85%	5,527	5.77%
Total	35,763	37.35%	38,472	40.18%
2013				
Public	15,193	12.31%	15,770	12.78%
P-P school	26,243	21.27%	28,243	23.28%
Private	4,092	3.32%	5,331	4.32%
Total	45,528	36.90%	49,344	40.38%

Source: own elaboration with data from SIMCE.

Overall the [Table 2](#) provides a comprehensive overview of the distribution of the students across different type of schools and communes in Chile; it also highlights a significant role played by public schools in small towns and towns, covering to 63% and 43% of the surveyed students, respectively. However, as the size of the town increases, it is observed

the decrease in the percentage of public schools coverage, with public-private and private schools accounting for 70% and 73% of the covering in cities and large cities, respectively.

This classification is considered for estimating the measure to what extent the students with different income levels attend to different type of schools, in doing so, it reveals the presence of income segregation. Similarly, it is useful to assess to what extent students are classified according on their achievement, highlighting the existence of score segregation.

In this regard *Lasso de la Vega and Volij (2020)* characterized a continuous index of income segregation, known as School Segregation Index, which assesses segregation by quantifying the differences between district's variability and schools. This variability is measured by using the logarithmic deviation, which it could be considered as the measurement of income segregation.

The school segregation index is defined by

$$SSI(x) = \sum_{C \in x} \frac{nc}{nx} \ln \left(\frac{ux}{uc} \right) ;$$

A set of schools that belong to some certain geographical area is represented by x . Within this set of schools, C represents each specific school. In this context, nc represents the number of students in school C , and nx represents the total number of students across all schools in set x . The term \ln denotes the natural logarithm. Within this expression ux represents the average income or score of all students in all schools within the set x , while uc represents the average income or score of students in school C .

Once the index is applied, we can assess whether there is segregation between schools in terms of income and achievement based on the selected type of cities. The proportion of communes considered in small towns is 7.3%, and in towns, 12%. Meanwhile, cities account for 37% of the sample, and large cities make up 44%. These figures allow us to estimate both measures and get conclusions regarding segregation in each type of city. Thus, our initial research question focuses on determining the impact of Michelle Bachelet Jerias' educational reforms on school segregation between 2013 and 2019.

To go deeper into the factors influencing student's achievement, we aim to explore both internal and external elements within the school environment. This requires examining various variables that may influence students' achievements. Such variables are characterized as personal, parental and background influences. Hence, our second research question focuses on whether students' characteristics will have an impact on their academic scores.

To test their effects we use OLS regression, as illustrated below:

$$y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \dots + \beta_k X_{ki} + u_i \quad i = 1, 2, \dots, n$$

We use OLS regression because of its effectiveness in estimating the relationship between the independent variable and the dependent variable. We conducted some preliminary checks; and we visually inspected the shape of the dependent variable and found it follows a similar shape of a normal distribution, the kurtosis indicated that the distribution measure is 2.5 very close to 3 and Skewness of 0.14549 close to zero (*Kenton, 2023*). Similarly, we used robust standard error in the regression analysis, which implies the standards errors of the coefficient estimates will be adjusted to account for potential heteroscedasticity in the residuals.

We hypothesize that the variables used in the model will have a significant positive or negative influence on the scores used in SIMCE. Although, we also expect that some variables will have stronger influences than others, especially those who are part of what can be done by the student, for instance, those variables that act as distraction and can be considered as effort variable can have a higher impact than those who are related with income or access to schools.

In this study we focus on examining two significant variables categorized into clusters, those are referred to as circumstantial and effort variables. Consequently, in this regard, *Jusot et al. (2013)* explored the relationship between “circumstantial” and “effort” factors within the context of health, emphasizing the significance of addressing this relationship, due to its significance is mainly driven by social backgrounds.

There are numerous examples of school segregation influenced by socioeconomic, ethnic, nationality or even religious factors in Chile. Consequently, in alignment with the work of *Oyarzún et al. (2022)* whose research highlights the association between ethnicity particularly the Mapuche ethnicity and the background of Latin-American immigrants’ parents, they both result in disparities when it comes to request access to the Chilean education system. As a result, the variable “Ethnicity” examines the students’ ethnic background in relation to Chilean students and the variable “Nationality”, distinguishes family participants based on their nationality, indicating whether the student’s parents are Chileans or foreign nationals. Additionally, we include the variable “Gender” in order to capture the differential effect of being female compared to being male.

We aim to highlight the significant correlation between socioeconomic status and the intellectual performance into children’s achievement, particularly in regards to their socioeconomic background. To achieve this goal, we include variables such as income, as well as the educational level of both fathers and mothers. In this matter, the research of

Von Stumrn and Plomin (2015) highlight that students with lower socioeconomic backgrounds tend to perform less favorably on intelligence test compared to their counterparts from higher socioeconomic status. As a result, we introduce the variable “Ln_income”, which represent the logarithm of family income. When assessing parental education, we categorize both mother and father education into four different levels: none, primary, secondary, and superior education. This allows us to analyze the impact of having a greater education in regards to not having at all.

As mentioned before *Gorard and Fitz (2000)* consider that segregation is associated to demographic changes and local factors. Thus, we assess the urban areas in terms of size, labeling the variable as “City size”. This considers examining the differential effect of being part to a small town versus a large one. Furthermore, we explore the variable “Dependency”, evaluating the differential effect of being part of public-private and private in regards to public education, while the variable “school resources” asses the quality of human resources provided by the school. This assessment categorizes resources as none, low, medium and high dotation of human resources provided. Consequently, we evaluate the differential effect of having dotation of human resources in regards to having none dotation. These selected variables are in line with our strategy of separating geographic regions, allowing us to better capture disparities across areas, particularly when contrasting smaller areas with larger ones, due to budget disparities and the significant prevalence of public schools in remote regions.

Among the factors affecting effort, we take into account the variable called “Attitude” as a means of assessing school engagement. This factor considers the student level of motivation and involvement towards its education. This specific aspect of education has recently been explored by *de Toro et al. (2023)*, whereas their studies show the connection between academic engagement and academic achievement, and find results particularly high in female students in Chilean primary education. The study underscores also the significance of behavior within the engagement, which can be enhancing through participation in school-related activities. Thus, the “Attitude” variable is classified into four levels: None, Low, Medium, and High engagement. Additionally, another aspect we considered is the “Behavior”, assessing student conduct and its implication their overall academic performance, this involve investigating whether a student has faced expulsion due to misconduct more than once, in regards to none. Additionally, we examine a way of distraction for students in class, which involve the variable “Use of Cellphone”, which refers to the utilization of mobile phone during class, in regard to those students who do not use it in class.

Therefore the study aims to analyze how these variables interplay and contribute in the achievement named “average_score”, which considers the average of mathematics, language and social sciences. By understanding the relationship between these variables we expect to gain valuable insights into the factors that influence academic achievement in the chosen regions.

Table 3 shows the basic summary statistics of the variables used for our analysis of estimating achievements. As it can be seen, the descriptive statistics show dummy variables, discrete variables, and the primary continuous variables. As dummy variables we consider mainly personal characteristics and educational settings. In regards to discrete variables it is considered students’ background referring to parents and schools dependencies. Finally, achievements are considered as a dependent variable whereas we estimate the average score of mathematics, reading and social sciences.

Table 3. Summary statistics of explanatory variables

City and large city					Town and small town			
Continuous variables	Mean	Std.dev	Min	Max	Mean	Std.dev	Min	Max
2019								
Average score	258.02	43.86	139.12	388.25	246.80	41.33	148.30	374.90
City and large city					Town and small town			
Continuous variables	Mean	Std.dev	Min	Max	Mean	Std.dev	Min	Max
2019								
Income	823.92	676.66	50.00	2,300.0	513.96	471.85	50.00	2,300
Discrete variables	1	2	3	4	Dummy variables	City and large city	Town and small town	
2019								
Father education	0.23%	13.61%	54.73%	31.43%	Female	50%	50%	
Mother education	0.20%	12.15%	55.99%	31.67%	Chilean	93%	97%	
School resources	3%	9%	50%	38%	Native	9%	21%	
Dependency	33%	56%	11%	0%	Bad behavior	9%	11%	
Attitude	3%	10%	52%	36%	Use of Cellphone	27%	21%	
Variables overview	1	2	3	4	Variables overview	0	1	
Father education	None	Primary	Secondary	Superior	Gender	Female	Male	
Mother education	None	Primary	Secondary	Superior	Nationality	Chilean	Other	
School resources	None	Low	Medium	High	Ethnicity	Native	Non - native	
Dependency	Public	Public-private	Private	N/A	Behavior	Missconduct	Good behavior	
Attitude	None	Low	Medium	High	Use of cellphone	Yes	No	

Source: own elaboration with data from SIMCE.⁵

⁵ N/A: Not applicable for School dependency.

3. Empirical results

We estimate the SSI index using data from 2013 and 2019 samples for four types of cities, categorized based on their population characteristics as shown in *Table 4*. Mainly our findings indicate an overall decrease in income segregation in schools between 2013 and 2019. However, when examining the results by regions, we find that in small towns categorized as type 0 which represent 7.03% of the total regions selected, the income segregation remains present and even it is increased particularly in Antofagasta region located in the north of Chile. Thus, Antofagasta accounts for 0.05% of the total communes in 2019 and 0.04% for 2013.

Table 4. Income segregation

Income - 2019		Small town - type city = 0				Town - type city = 1				City - type city = 2				Large City - type city = 3			
Region	TLL% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop
Tarapacá	0.3%	0.036	0.249	14%	0.03%	N/A	N/A	N/A	N/A	0.111	0.300	37%	0.29%	N/A	N/A	N/A	N/A
Antofagasta	1.2%	0.028	0.203	14%	0.05%	0.034	0.246	14%	0.08%	0.109	0.293	37%	0.35%	0.121	0.292	41%	0.70%
Valparaiso	7.5%	0.075	0.261	29%	1.16%	0.137	0.314	44%	2.04%	0.113	0.287	40%	2.06%	0.177	0.349	51%	2.22%
Metropolitana	72.4%	0.050	0.222	23%	1.18%	0.133	0.317	42%	5.46%	0.184	0.345	53%	28.73%	0.156	0.322	48%	37.03%
Bio Bio	10.6%	0.075	0.293	26%	2.14%	0.062	0.258	24%	1.83%	0.168	0.332	51%	5.22%	0.153	0.328	47%	1.45%
La Araucanía	8.1%	0.099	0.380	26%	2.47%	0.115	0.325	35%	2.86%	0.065	0.275	24%	0.53%	0.187	0.362	52%	2.24%

Income - 2013		Small town - type city = 0				Town - type city = 1				City - type city = 2				Large City - type city = 3			
Region	TLL% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop
Tarapacá	0.3%	0.053	0.293	18%	0.03%	N/A	N/A	N/A	N/A	0.163	0.354	46%	0.28%	N/A	N/A	N/A	N/A
Antofagasta	1.2%	0.018	0.226	8%	0.04%	0.041	0.275	15%	0.08%	0.109	0.313	35%	0.37%	0.143	0.318	45%	0.68%
Valparaiso	8.2%	0.118	0.295	40%	1.26%	0.173	0.353	49%	2.18%	0.160	0.338	47%	2.31%	0.160	0.434	37%	2.41%
Metropolitana	71.5%	0.070	0.243	29%	1.18%	0.194	0.366	53%	5.04%	0.268	0.428	63%	28.49%	0.225	0.390	58%	36.83%
Bio Bio	10.7%	0.079	0.300	26%	2.28%	0.077	0.272	28%	1.88%	0.236	0.414	57%	5.08%	0.172	0.357	48%	1.46%
La Araucanía	8.1%	0.121	0.384	32%	2.47%	0.151	0.387	39%	2.86%	0.078	0.277	28%	0.52%	0.252	0.454	55%	2.25%

Source: own elaboration with data from SIMCE.⁶

For other regions, mostly segregation decreased in both periods. Although in 2019, it is found that inequality can be explained by segregation, with 26% for Bio-Bio and La Araucanía region, 23% for Metropolitana, accounting for 2.14% of the communes, also inequality can be explained by segregation in 29% for Valparaiso and 14% for Tarapacá, accounting for 1.16% and 0.03% of the communes, respectively. The results for 2013 do not differ significantly, except for the fact that Valparaiso reduced its income segregation significantly.

Likewise, for towns categorized as type 1 across various regions, most experience their school segregation index (SSI) decreased. Slightly decreased for Antofagasta, in which 14%

⁶ N/A: Not applicable for Tarapacá.

of the inequality observed can be attributed to segregation in both years, accounting for 0.08% of the total communes considered, respectively. For the regions Metropolitana and Valparaíso, on average, 44% of the inequality in 2019 and 51% in 2013 can be explained by segregation, accounting for 5.46% and 2.04% of the total communes considered, respectively.

A more visually detailed representation can be observed for cities type 0 and 1 in figure 1:

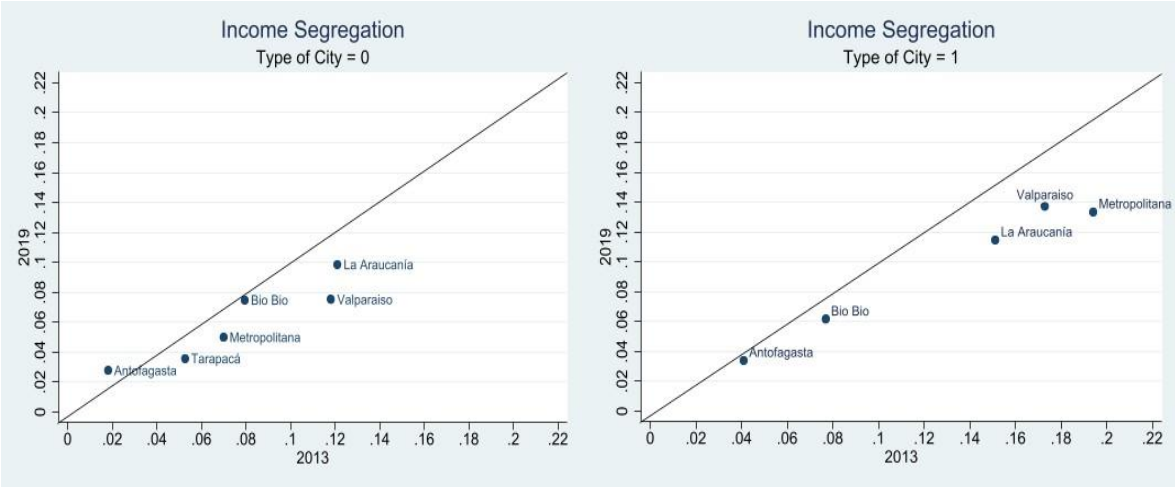


Fig 1. Graphic representation of income segregation in schools - years 2013 and 2019

Source: own elaboration with data from SIMCE.

For cities and larges cities categorized as type 2 and type 3, the pattern is similar; we notice that income segregation is decreased but present for larges cities. However, it decreased for most of the regions except for Antofagasta and Valparaíso in type 2 and type 3, respectively.

In case of cities type 2 it can be noticed that inequality can be explained by segregation in percentages surpassing 50% in regions such as Bio-Bio and Metropolitana for both years. These regions accounted for 28.73% and 2.31% of the total communes considered, respectively.

Notably, even in large cities type 3, where higher indexes of income segregation are typically common, a reduction is observed across the selected regions, with the exception of the Valparaíso region in the central part of Chile. This particular region accounted for 2.2% of the total selected communes.

A more visually detailed representation can be observed for cities type 2 and 3 in figure 2:

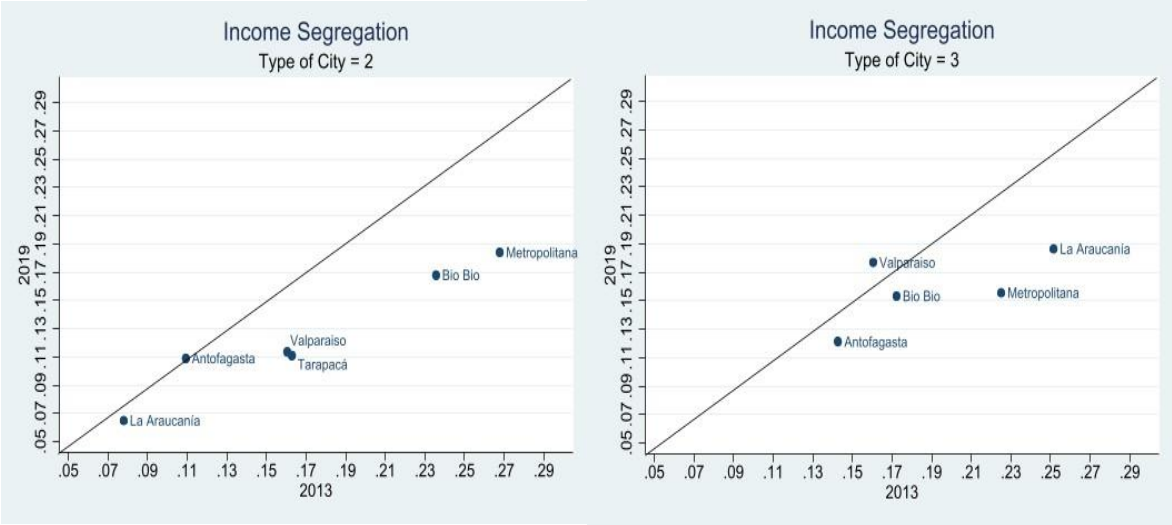


Fig 2. Graphic representation of school segregation in school- years 2013 and 2019.

Source: own elaboration with data from SIMCE.

These findings highlight the dynamics of income segregation in different urban settings and could offer good insights for addressing educational disparities to seek for more inclusive learning environment. It would be worth wondering if there is any relation with the fact that most of the public-private schools started a process in 2017 that made them switch from public-private to public, eliminating the co-payment established by law in 1989. Up to now we now that 3020 schools already finished their status of “Subvencionado” or public-private , representing 98% of them, started a new process as public, this fact suggest further research to see whether the segregation in school decreased due to this fact among others. ⁷

When examining the specific impact of score segregation, our analysis, as presented in *Table 5*, does not reveal any significant evidence of it in the majority of the regions studied. Therefore, we can infer that there is no score segregation observed by school, which it means that there is no indication of better scores being concentrated in schools with certain characteristics.

⁷ Ministerio de educación de Chile. Overview. Retrieved from : <https://www.mineduc.cl/3-020-particulares-subvencionados-ya-se-convertido-establecimientos-sin-fines-lucro/>

Table 5. Score segregation

Average Score - 2019		Small town - type city = 0				Town - type city = 1				City - type city = 2				Large City - type city = 3			
Region	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop
Tarapacá	0.3%	0.002	0.014	15%	0.03%	N/A	N/A	N/A	N/A	0.003	0.014	24%	0.28%	N/A	N/A	N/A	N/A
Antofagasta	1.2%	0.002	0.014	15%	0.04%	0.002	0.015	12%	0.08%	0.003	0.014	21%	0.37%	0.005	0.015	31%	0.68%
Valparaíso	8.2%	0.003	0.014	21%	1.26%	0.004	0.014	27%	2.18%	0.004	0.014	27%	2.31%	0.005	0.015	35%	2.41%
Metropolitana	71.5%	0.002	0.013	15%	1.18%	0.004	0.015	28%	5.04%	0.006	0.016	35%	28.49%	0.005	0.015	32%	36.83%
Bio Bio	10.7%	0.003	0.014	23%	2.28%	0.004	0.014	24%	1.88%	0.004	0.014	28%	5.08%	0.003	0.013	25%	1.46%
La Araucanía	8.1%	0.003	0.013	23%	2.47%	0.004	0.014	25%	2.86%	0.002	0.012	18%	0.52%	0.005	0.015	33%	2.25%

Average Score - 2013		Small town - type city = 0				Town - type city = 1				City - type city = 2				Large City - type city = 3			
Region	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop	Seg	Ineq.	Pure Seg	% pop
Tarapacá	0.3%	0.002	0.012	13%	0.03%	N/A	N/A	N/A	N/A	0.006	0.016	37%	0.28%	N/A	N/A	N/A	N/A
Antofagasta	1.2%	0.001	0.013	10%	0.04%	0.003	0.014	20%	0.08%	0.005	0.014	34%	0.37%	0.006	0.015	39%	0.68%
Valparaíso	8.2%	0.003	0.012	23%	1.26%	0.004	0.013	33%	2.18%	0.005	0.013	35%	2.31%	0.005	0.013	34%	2.41%
Metropolitana	71.5%	0.003	0.013	22%	1.18%	0.005	0.014	34%	5.04%	0.006	0.015	40%	28.49%	0.006	0.014	40%	36.83%
Bio Bio	10.7%	0.003	0.013	26%	2.28%	0.004	0.013	28%	1.88%	0.005	0.014	35%	5.08%	0.004	0.012	36%	1.46%
La Araucanía	8.1%	0.003	0.012	26%	2.47%	0.004	0.013	31%	2.86%	0.004	0.012	32%	0.52%	0.005	0.013	36%	2.25%

Source: own elaboration with data from SIMCE.⁸

In order to interpret the results done in the ordinary least square regression, we focus on two circumstance variables such as family background and personal characteristics, as well as effort variables. In *Table 6* the R-squared indicates that 22% of the variability in the score of primary schools can be explained by the included circumstance's variables.

Regarding gender, it is observed that, on average, women score 2.82 points higher than men, and this difference is statistically significant with a p value of 0.001. However, there is no significant relationship between belonging to a specific native culture and school scores. Regarding family income, we find that one-unit increase in the logarithm of income resulted in a significant 6.95 point increment, with a p value of 0.001.

Furthermore, the nationality of the parents has an impact in the student scores, with Chilean parents resulting in an 8.04 points increase. Notably, the effect of father and mother education differs depending on the type of education attended. Fathers attending to basic schools do not have a significant impact regarding the ones who did not attend, but for secondary and upper education, the impact is 6.2 and 14.2 points on average scores, respectively.

⁸ N/A: Not applicable for Tarapacá.

Similarly, the impact of mother education is higher for secondary and upper studies regarding none studies, with impacts of 11.9 and 18.6 points on the average score, respectively. This result aligns with existing literature (see for instance *Lasso de la Vega et al. 2020*) that suggests higher education of the mother would have a greater impact, which is precisely the case here.

Continuing with the study, we focus on school background and find that having human resources support students have a significant impact in regards to having none, accounting for an average score increase of 9.09 and 11.21 for having low and medium endowment of human resources provided, as indicated by the “school resources” variable, what it is interesting, the high endowment the less the average score, specifically 6.97 impact in average score, which it may tell us something about how the optimal level of support might be found and suggesting a relationship between school resources and student achievement is not particularly highly correlated.

Additionally, we validate a previously established fact concerning town size. Being part of a small towns has a negative and significant effect, resulting in an average score reduction of approximately 2.2 points for primary schools.

Considering the schools dependency, we find that attending to a private school has a significant and positive impact, leading to a 24 point increase in the average score compared to attending a public school. Furthermore, attending a public-private school has a significant positive, with 8.6 points increase in the average score.

We evaluate also the students’ attitudes towards the effect of education in their lives. We find that having positive and high attitude towards the future has a significant impact, increasing the average score in 23.77 points compared to those who lacked a sense of a promissory future in a significant way. If medium attitude is present, the impact is 16.76 points and 11.34 when is low attitude regarding having none significant attitude.

Finally, we examine what could be considered as an indicator of students’ effort, the first one we consider is the use of cellphones as a way of distraction in classroom, which impact negatively and significantly in the average score, leading to a 10.8 point decrease in the average score. Moreover, when checking the behavior in classes, we evaluate whether the students were expelled for misconduct more than once, finding that being expelled from school more than once impact negatively, resulting in a 15 point decrease in the average score.

Overall, our analysis reveals several factors related to average scores, although, we acknowledge that there might still be some unexplained factors influencing school scores. To further enhance the explanatory power of our model we suggest going deeper into the

dynamics within classrooms. Exploring the classroom environmental and instructional practices can potentially reveal valuable insights that can contribute to a more robust understanding of academic performance.

Table 6. Ordinary least square regression

					Num. Obs	95.751
					R-squared	0.22
					Root MSE	38.51
Average Score	Coefficient	Robust std.err.	t	P > t 	[95% conf. Interval]	
Gender (Female)	2.820796	0.2512853	11.23	0.000	2.32828	3.3133313
Ethnicity (Native)	-0.196734	0.4049299	-0.49	0.627	-0.9903922	0.5969241
Ln_income	6.950185	0.1990978	34.91	0.000	6.559956	7.340415
Nationality (Chilean)	8.048708	0.544302	14.79	0.000	6.981883	9.115534
Father education (None)						
Primary	0.9315153	2.409634	0.39	0.699	-3.791341	5.654371
Secondary	6.241664	2.405942	2.59	0.009	1.526044	10.95728
Superior	14.27885	2.42563	5.89	0.000	9.524643	19.03306
Mother education (None)						
Primary	4.812936	2.626549	1.83	0.067	-0.3350702	9.960942
Secondary	11.96978	2.622042	4.57	0.000	6.830602	17.10895
Superior	18.64179	2.640098	7.06	0.000	13.46723	23.81636
School_resources (None)						
Low	9.092904	0.8370546	10.86	0.000	7.452286	10.73352
Medium	11.21635	0.7442736	15.07	0.000	9.757577	12.67511
High	6.978706	0.7578672	9.21	0.000	5.493295	8.464118
City_size (Small Town)	-2.286689	0.309076	-7.17	0.000	-2.820342	-1.608842
Dependency (Public)						
Public-private	8.6540023	0.2897972	29.89	0.000	8.086508	9.221538
Private	24.62507	0.5398788	45.61	0.000	23.56692	25.68323
Attitude (None)						
Low	11.34401	0.878722	12.96	0.000	9.670123	13.11469
Medium	16.76551	0.8006396	20.03	0.000	15.26561	18.4041
High	23.7747	0.8154716	29.23	0.000	22.23666	25.4333
Use of Cellphone	-10.89876	0.2879526	-37.81	0.000	-11.45315	-10.32438
Behavior	-15.67467	0.4070989	-38.5	0.000	-16.47258	-14.87676
_cons	151.2452	3.518566	42.98	0.000	144.3488	158.1415

4. Conclusions

The present study analyses the academic achievement of primary Chilean school students in Chile and explores the variations in income segregation among schools in different regions of the country. The study uses data from SIMCE databases for the years 2013 and 2019, incorporating responses from students, parents and school questionnaires. The applied methodologies are based on the use of school segregation index (SSI) and the ordinary least square (OLS) method. The focus of the conclusions centers on the changes observed in the SSI and the factors influencing students' achievement.

One of the most significant factors contributing school segregation is separation of students with different income levels attending to separate school. Although the results show a decrease in school segregation in the main regions, it is still present in small towns and larger cities, and is particularly evident northern cities of Chile, where disparities have emerged. In this regard, it is essential to assess various influencing variables such as migration, poverty and overpopulated areas, where these differences are more visible. Breaking down the root of these issues may not be straightforward, especially considering that north regions contribute significantly to Chile's economy. Specifically, these regions are responsible for producing 11.5% of the Chilean GDP due to copper extraction, and represent, for instance, six times the GDP of La Araucanía region, as indicated in a study by *Díaz et al. (2020)* which established a positive relationship between migration and regional growth. As a result, it becomes crucial to evaluate public policies that provide equal distribution of resources in regions with diverse income distribution due to the risk of resource saturation and the presence of overpopulated areas that may remain beyond the reach of the government intervention.

Promoting inclusivity and enhancing educational opportunities is vital to consider variables like gender and family background, which are variables that were found to be significant for both, accounting for 2.8 and 6.9 points, respectively. In the context of academic performance, these results align with *Von Stumm and Plomin (2015)* mentioned before where we hypothesize the fact that family background could eventually influence academic performance. Additionally, supporting students not only through education but also by creating an environment where they feel at home is crucial, as the human resources variables play a significant role in academic achievement. While the focus should not only be on equalizing the poor with the richest, the study emphasizes that classroom experiences play a more substantial role in students' achievement than mere economic disparities. There are numerous examples of socio-economic or academic school segregation across countries. However, in this case, scores segregation shows no impact, unlike by income segregation, but as discussed earlier, academic segregation

becomes noticeable within classroom, this fact was studied by *Treviño et al. (2016)* they concluded Chilean schools tends segregate students based on abilities in classrooms and factors such as schools size and students characteristics are the ones that increase the probability for schools to segregate. This issue could be eventually happening due to the reason the schools have to compete for incentives created by the Chilean system, for instance , well known is the incentive for a good performance in SIMCE test, and that is something that could suggest further research. What we could conclude in fact from our study is that the city size and the type of dependency are variables that have a significant impact not only in achievements but in the measure of income segregation. Due to a high heterogeneity given by a big territory, further research it could be suggested in regards to the curriculum implemented by regions; for instance, having a uniform curriculum across a large and very heterogonous country it is something that can be taken into account, because it is particularly relevant when considering the numerous differences across regions and cities. This unique approach ignores the different educational needs, cultural context and geographical factors that influence the learning experience.

Consequently, income segregation becomes relevant when considering other elements such as remoteness and schools resources that further perpetuate unequal educational scores. Particularly noticeable is the situation in smaller cities and remote areas, thus, the geographical isolation amplify the challenges of academic segregation, our study concludes that the academic performance improves with the size of the city. Additionally, when adding the variable of the schools' dependency, the gap increases even further. Specifically, showing a 24-point difference when comparing public schools, the disparity becomes more pronounced, considering the fact that public education coverage in small towns account for 63% of the surveyed student. Notably, the transformation of the educational system in 2017, which transferred public education administration from municipalities to government institutions and encompassed both public and public-private institutions, seems aligned with our findings. This alignment holds true if we assume the admissions in schools do not influence educational achievements. In this regards, *Contreras et al (2010)* studied this matter and by managing diverse selection criteria, their research concluded there are no noticeable variations in the educational achievement between public and public-private schools.

Also a primary finding indicates that parental socio-economic status has positive effect of 6.9 points on academic achievement. However, it is even more pronounced the impact of attitudes toward the future, accounting 23 points on the academic achievement as well as the behavior of students in class. This finding is particularly aligned with our previous hypothesis mentioned in section 2 when highlighted the study done by *de Toro et al. (2023)* in Chilean schools, in which they mention the strong relationship between attitude

and academic achievement. In this regard, we suggest further research to those with low attitude to help policy makers to identify why students loose this attitude or whether part of a peer effect in certain schools as well the study of the behavior in classes which is shows a reducing 15 points in the academic achievement.

As a conclusion, this study highlights the dynamics of academic achievements, income segregation, and the factors influencing these aspects among primary Chilean education in schools. Through the analysis of data from SIMCE and the application of various methodologies, the study points out the challenges settled by income segregation among schools, particularly in smaller cities, and remote areas. While the decrease observed in main regions is promising, the disparities found in the north of Chile emphasize the need for targeted policy intervention. Furthermore, the study remarks the critical role of classroom experiences and the influence of factors such as parental socio-economic status, attitudes towards the future of students' education in shaping their academic scores. As we look ahead, addressing income segregation requires systematic approach that considers regional disparities, schools resources, technology integration and boosting the learning environment, ultimately contributing to a more equitable and enriched educational landscape for all Chilean students.

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