Article

'Neighbourhood effects' on children's educational achievement in Chile: The effects of inequality and polarization

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Abstract

This article studies the effects of the neighborhood in which a school is located on children's mathematics achievement in Chile. It uses data taken from a sample of 127,020 sixth grade students measured by the National Education Quality Measurement System [Sistema Nacional de Medición de la Calidad de la Educación]. The incorporation of a measurement of socio-economic polarization of the geographic environment, which is innovative in urban studies, allows us to qualify some critical aspects suggested in the academic discussion. A lagged dependent variable model is used, controlling for the score obtained by the same students in fourth grade. Using multilevel linear regressions, the results show positive effects related to participation in neighborhood organizations. One critical finding is that socio-economic polarization has a negative and significant impact on the educational achievement of sixth graders. The conclusions highlight the repercussions associated with acute inequalities in the neighborhoods, and speak to the importance of accessing dimensions which are more closely linked to cities' social structure.

Introduction

Over 20 years ago, studies conducted by William Wilson, Christopher Jencks and Susan Mayer presented the effects of growing up in poor communities, mainly on processes such as collective socialization, the influence of peer groups and the institutional capacity to cover

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basic services (Jencks and Mayer, 1990; Wilson, 1987). The assessment of these authors had a strong influence on later studies on *neighbourhood effects* (van Ham et al., 2012).

In this approach, researchers share the hypothesis that life in poor or disadvantaged neighborhoods has a negative impact on residents' life opportunities beyond the effect of their individual characteristics. In practice, *neighbourhood effects* have been studied in terms of job opportunities, child development and deviant behavior, among other outcomes (Durlauf, 2004; Ellen and Turner, 1997; Sampson et al., 2002). Special attention has been paid to contributions aimed at identifying variations in children's educational performance. A recent meta-analysis that includes only developed countries shows that the association between neighborhood conditions and educational results has mainly been explained by the concentration of poverty, the learning environment, the relative frequency of the ethnic/immigrant population and the social disorganization of the reference contexts (Nieuwenhuis and Hooimeijer, 2016).

Despite the increase in research in this area, this field has been criticized a fair amount in recent years. Some authors have suggested that some studies report causal evidence, although the information used only provides correlational evidence (van Ham and Manley, 2012; van Ham et al., 2014). Others have offered critiques of the socialization and interaction mechanisms used to interpret the findings, in that they would represent conceptual devices for which there is a clear black box (Miltenburg, 2015). Authors from Marxist urban theory argue that the main thesis of the discussion ignores a much more important structural problem: why people live where they live in the first place (Slater, 2013). From this perspective, it seems more substantive to examine the macroeconomic factors that make possible the existence of social inequalities in individuals' life opportunities (López-Morales, 2015).

Based on this debate, in this study, we focus on how characteristics of the geographic surroundings of schools affect the educational achievement of children in the sixth grade in Chile. We use panel data from the Education Quality Measurement System [Sistema Nacional de Medición de la Calidad de la Educación, SIMCE], as well as data from the Chilean Ministry of Defense and the National Socio-economic Characterization Survey [Encuesta de Caracterización Socioeconómica Nacional, CASEN]. These are unique data which are generally not available in the literature. Our general hypothesis is that the characteristics of the geographic surroundings of the school produce an impact that exceeds individual, school, and family experience. The analysis developed refers to various theoretical mechanisms described in the literature (Ellen and Turner, 1997; Galster, 2012). We refer to collective socialization processes and the institutional characteristics of neighborhoods (Ainsworth, 2002, 2010; Andersson and Malmberg, 2015), although we know that its operationalization has been fairly imprecise (Ainsworth, 2010; Harding, 2011; Miltenburg, 2015). Therefore, we focus mainly on some innovative distinctions regarding the relative deprivation that is produced in the geographic areas of interest through measurements of inequality and socio-economic polarization (Esteban and Ray, 1994). Finally, we emphasize the importance of social cohesion for mitigating the effects of the environment through an indicator of local participation.

Our research contributes to the following points: First, we analyze data from the Latin American context regarding which the literature does not provide a great deal of information. We focus on Chile, a developing nation that presents high geographic segregation (Garretón, 2017), elevated inequality and limited social mobility (Contreras et al., 2010, 2014; Núñez and Miranda, 2010; World Bank, 2015). The most recent research in Chile has revealed unequal and growing urban expansion supported by high indicators of socio-spatial segregation, gentrification, increased numbers of closed

communities, socio-spatial fragmentation and the construction of public housing in locations well outside of the city center that are characterized by a lack of adequate public services (Borsdorf et al., 2016; Garretón, 2017; López-Morales, 2015). Second, the study focuses on students who are entering adolescence (ages 11 to 12), where the potential impact of the neighborhood's characteristics is most convincing given that children spend less time with close family members and more time relating to peers (Ainsworth, 2002; Ellen and Turner, 1997; Leventhal and Brooks-Gunn, 2000; Nieuwenhuis and Hooimeijer, 2016). Third, panel data are used on a robust sample of more than 120,000 students, mitigating one of the major problems that studies in this area face. While the majority of the *neighbourhood effects'* theoretical mechanisms have to be measured successively to be identified (Musterd et al., 2012; Sharkey and Faber, 2014), a good number of studies do not control for unobservable characteristics through lagged dependent variables. However, this is very important for obtaining reliable evidence given that residences are not randomly distributed in geographic areas but instead are grouped within those contexts based on their socio-economic conditions. In practice, the effects identified in the research that do not have prior educational information could be due to the grouping of children with a certain educational level in specific neighborhoods (Nieuwenhuis and Hooimeijer, 2016). The importance of this empirical strategy is even higher in Chile, where the possibility of choice and residential mobility is very low. In fact, the resources available to families are easily identifiable based on municipalities. According to this spatial segregation, the majority of low-income families do not have more favorable school choices near their homes or do not have the resources that they would need to get to other parts of the city (Elacqua, 2012; Schneider et al., 2006). Fourth, data on multiple contexts that can affect children's academic performance (e.g. individual, household, school) are also accessed, following contributions made by previous studies (Brännström, 2008; Cook et al., 2002; Kauppinen, 2008; Owens, 2010; Sykes and Musterd, 2011) and seeking to avoid omitted variables bias (van Ham et al., 2012). This is essential because the studies that control for the variables of household and school context generally have found weaker *neighbourhood effects*, which makes the estimates reported more believable (Nieuwenhuis and Hooimeijer, 2016). Fifth, this study is focused on the geographic environment of the school, an innovative context for studies in this field, which mainly focus on the area surrounding the residence. However, given that 87.6% of elementary school students considered in this study attend schools within their district of residence, in practice the geographic context of the school operates as a proxy for the students' residential environment. Therefore, this area is relevant because it is the youth's place of residence/study, where they spend a lot of time. As such, the theoretical mechanisms that have been given to interpret *neighbourhood effects* also should be useful in our case study. Furthermore, under these conditions, the eventual effects of the school (e.g. type of school, SES) could be easily interpreted as problems related to the provision of institutional resources in the neighborhood.

Socialization mechanisms of *neighbourhood effects* and social inequalities

Collective socialization processes and social cohesion

William Wilson, Christopher Jencks and Susan Mayer suggest that the impact of neighborhoods' characteristics on educational achievement emerge through the influence of peer groups, collective socialization processes, and institutional capacity to provide basic services (Jencks and Mayer, 1990; Wilson, 1987). In general, the composition of the

neighborhood is said to have a potential negative impact on children's attitudes and behaviors towards education. In practice, these patterns of socialization are thought to have their own dynamics (e.g. contagion, auto-replication, imitation) above and beyond their initial cause, generally structural or environmental (Harding, 2011).

On the one hand, the influence of *neighbourhood effects* on the collective socialization processes of children has been highlighted, mainly through social norms mobilized by adult residents of these areas (Ainsworth, 2002, 2010). Specifically, researchers have found that when children and adolescents are exposed to negative role models outside of their homes, they may present a tendency not to value education and mechanisms that lead to better attitudes and academic outcomes (Cutler and Glaeser, 1997; Jencks and Mayer, 1990; Sampson et al., 2002). This usually occurs in poor areas, where a relatively high number of adults lack sufficient education and employment, exhibit criminal behavior or communicate discourses that go against the ideals and values of society in general (Miltenburg, 2015; Wilson, 1996, 1987). The latter problem has received a great deal of attention from the theory of social disorganization (Sampson and Groves, 1989; Sampson et al., 1997). In this regard, children do not have direct proof that favorable attitudes and behaviors regarding education translate into future benefits, such as finding a good job (Ainsworth, 2002). On the other hand, some authors propose that peer effects subscribed to the immediate neighborhoods and school environments have substantial consequences on academic performance (Crane, 1991). This occurs because good or bad behaviors of some children may be contagious and thus modify results, attitudes, aspirations, expectations, and favorable or unfavorable values around education (Durlauf, 2004; Ellen and Turner, 1997). Moreover, it has been indicated that when these negative attitudes become normal (e.g. dropping out, bad grades), it can be more likely for them to be tolerated and reproduced (Nieuwenhuis et al., 2013).

An extension of these socialization models suggests that neighborhoods can indirectly affect the academic performance of children and adolescents through institutional mechanisms (Ellen and Turner, 1997; Jencks and Mayer, 1990; Leventhal and Brooks-Gunn, 2000). Researchers refer to access, quality and types of relationships developed in school with teachers and classmates (Ainsworth, 2002; Jencks and Mayer, 1990; Sykes and Musterd, 2011). For example, studies have found that schools located in economically disadvantaged areas face difficulties acquiring teaching resources, which means that the students are more likely to attend lower quality schools (Galster et al., 2007). In practice, the unequal geographic distribution of the educational institutions could significantly affect the schooling experiences of the children who study in lower income schools, and would reveal the government's failure to serve the most isolated communities or groups in society. In fact, it could be related to what Soja (2010) calls ''spatial injustice,'' as geographic limits that have been configured to reproduce structures of privilege.

Despite the influence of the socialization processes on children's academic results, some authors have emphasized the importance of mechanisms related to the social cohesion of neighborhoods for mitigating their effects. Researchers suggest that high levels of collective efficacy can have positive impacts on facing a range of problems that emerge in the urban space (Sampson and Groves, 1989; Sampson et al., 1997). In short, it has been found that communities with greater social controls are better able to combat crime and enforce social norms related to the value of education (Ainsworth, 2002; Sampson et al., 2002). The literature also suggests that neighborhoods that present greater participation in organizations can also more easily influence local governments, specifically in regard to improving infrastructure and institutions. In general, these are practices related to and produced in function of elements that are constitutive of social cohesion, namely trust

among residents, local networks and a sense of belonging in the neighborhood (Schiefer and van der Noll, 2016).

Relative deprivation and horizontal inequalities

The discussion of *neighbourhood effects* has suggested that the social inequalities perceived by people in their spatial environment can translate into conflictive interactions among residents. Specifically, the mechanism of relative deprivation suggests that economic inequalities that develop in the geographic area are perceived by residents and can impact them in many ways (Cutler and Glaeser, 1997). They may lead to behaviors related to rage, anger and resentment, and thus increase the likelihood of social conflicts, mainly those associated with the devaluation of norms and decrease in different results such as educational achievement (Bernburg et al., 2009; Ginther et al., 2000). Based on this, authors have claimed that children from disadvantaged neighborhoods may feel more comfortable in poor neighborhoods than wealthy ones (Jencks and Mayer, 1990). However, recent contributions from research in the field of economics allow us to make a small distinction and differentiation with regard to this last mechanism. Although perceived social inequalities can lead to social conflicts, from this perspective this disparity is thought to be more likely when there are acute horizontal inequalities (Stewart, 2008). Some researchers have suggested exploring specific aspects of social inequality more precisely through the classification and comparison of groups identified in function of different types of characteristics (e.g. economic, ethnic, religious). Some authors have argued that social tensions emerge due to the existence of groups that are relatively homogeneous internally but heterogeneous between each other. This social mechanism has been called polarization (Esteban and Ray, 1994). It refers to social differences that manifest when people who identify with a group or social class perceive the same type of alienation as the rest.

In general, it seems to us that the mechanism of polarization may be more appropriate for the Chilean context due to the patterns of segregation and gentrification described. We believe that this type of process has created more consciousness about socio-spatial inequalities in the residents of disadvantaged neighborhoods due to the ease of finding more affluent areas within the same district of residence or close to it. Given the intertwining of neoliberal urban development and the expansion of the school choice policy, one could suggest that people have recently been experiencing inequality of opportunities with more clarity than in the past, which could have a series of social ramifications. Following this argument, in this study we hypothesize that tensions produced in function of acute socio-economic inequalities could be associated with unfavorable academic outcomes.

Neighborhood and school effects on academic outcomes

The evidence of *neighbourhood effects* on academic outcomes has mainly been gathered in developing nations. Long-term research in the United States provides evidence of a variety of educational results such as the level of instruction, graduation, drop-out rate, attendance and evaluations obtained (Ainsworth, 2002, 2010; Benson and Borman, 2010; Cook et al., 2002; Crane, 1991; Owens, 2010). In Europe, the research has focused on testing the consequences of living in marginal geographic areas. The findings have mostly observed on the type of degree earned and academic or cognitive results (Brännström, 2008; Kauppinen, 2008; Nieuwenhuis et al., 2013; Sykes and Kuyper, 2009).

In general, the research on *neighbourhood effects* on academic outcomes has presented the difficulty of being unable to clearly delimit the repercussions of the geographic area (Nieuwenhuis and Hooimeijer, 2016). Many studies have omitted the fact that *neighbourhood effects* can be added to, multiplied by or substituted for effects attributable to the school context (Cook et al., 2002). Authors like Jencks and Mayer (1990) have considered that *neighbourhood effects* and school composition are closely related. Others, such as Ainsworth (2002), have suggested that it is likely that schools affect the educational outcomes of children and adolescents more significantly, precisely because of the environment created among students and the way that teachers relate to them.

In order to avoid omitted variable bias and review results that can be attributed to geographic conditions, some researchers have recently made an effort to include the school context in their studies. The findings are not very conclusive, but *neighbourhood effects* have not been roundly dismissed in any case. Cook et al. (2002) explore simultaneous contextual effects in the United States (neighborhood, family, school) and conclude that schools in particular have an impact on children's academic performance while the area of residence mainly impacts attendance and social participation. Brännström (2008) tests simultaneous outcomes in metropolitan areas of Sweden and shows that the characteristics of the schools tend to matter a great deal more than those that can be attributed to the surroundings. These results support those of the study conducted by Kauppinen (2008), who analyzed the Finnish context and found that when contextual variables are tested simultaneously, most of the neighborhood effect on academic achievement is cancelled out while most of the school effect is maintained. The evidence reported by Sykes and Musterd (2011) in a study on the Dutch context is much more categorical than the aforementioned studies. The authors show that the effects of the neighborhood of residence disappear when one controls for the school characteristics. These conclusions are very different from the findings reported by Owens (2010) for the North American context, which suggest that *neighbourhood effects* distinctively predict academic outcomes even after controlling for school characteristics. Furthermore, the author notes that the school does not seem to be capable of mitigating the effects of coming from socio-economically disadvantaged municipalities.

In Latin America, little research has been conducted on *neighbourhood effects* on academic performance (see Cervini, 2009; Katzman and Retamoso, 2007). Cervini (2009), who works in Argentina, has published the only study that shows similarities with our objective. That research was designed to estimate school performance in children but was mainly focused on school composition.

In short, evidence has been found that allows researchers to link the characteristics of the geographic area with educational outcomes in children and adolescents. The majority of these research projects have been conducted in developed nations and regions, especially the United States and Western Europe. The results reported over the past few years are generally small compared to the influence of individual characteristics (family and household). In spite of this, living and studying in schools in disadvantaged geographic contexts translates into decreases in several educational outcomes (level of instruction, attrition and performance).

In this study, we believe that the effects for the Chilean context could be greater and more relevant than for the European and North American contexts given that the case in question is an extreme case of social inequality and residential segregation. Though the Gini coefficient (50.5) has decreased by one point over the past decade (World Bank, 2015), this is a modest fluctuation compared to other countries in the region.

Research questions

Based on the objectives and following the theoretical mechanisms described above, we asked the research questions listed below:

(1) Is it possible to link the conditions of the school's geographic area to educational outcomes in children after considering individual characteristics, household and school?
(2) Can the collective socialization processes that take place within the neighborhood be associated with children's educational achievements?
(3) Can neighborhood participation as a social cohesion mechanism influence children's educational achievements?
(4) Is it possible to link relative marginalization, inequalities and geographic polarization to educational achievement in children?

The Chilean context

Chile is a particularly relevant case study because it has been described as a developing nation that presents major public policy challenges regarding equity in education (Hsieh and Urquiola, 2006). One key milestone for understanding the Chilean context is the education reform implemented in 1981 during Pinochet's dictatorship in order to promote the school choice model under the supposition that market adjustments are the best option for increasing school effectiveness. Key results of this process include the administrative transfer of schools to municipalities (municipal government) and the participation of private sector agents as providers of education in the public-school system. The reform generated a context that involves three types of providers. The first is public schools financed by the state and managed by local governments. The second is mixed-funding schools (which receive government subsidies) known as subsidized private schools, which are privately managed. The final group is paid private schools, which are financed by the parents and managed by private entities. Table 2 shows that in 2012, 35% of students were enrolled in public schools, 57% in subsidized private schools, and 8% in paid private schools. Despite this apparent heterogeneity, the majority of the parents end up choosing the school that best matches their socio-economic situation, with important restrictions on choice based on financial resources, academic requirements and the religious beliefs of the parents set by the school (Contreras et al., 2010).

After 35 years of the school choice model, the most recent findings support the idea that education reform has created clear segregation and inequality of educational opportunities, contradictions regarding the information that parents have available to them and significant differences around academic preferences by economic level (Contreras et al., 2010; Elacqua, 2012; Gubbins and Otero, 2016; Valenzuela et al., 2014). These results mainly affect public schools, and also have been reinforced by the high correlation between educational and geographic segregation (Schneider et al., 2006). In short, the most robust results indicate that the greatest effect of this quasi-market model has been allowing the exodus of the middle class from the public school system and promoting segregation and self-segregation, without a great deal of evidence of improvements in educational results (Hsieh and Urquiola, 2006).

Data and measurements

Educational outcomes data

This study uses SIMCE data, which are based on a set of standardized tests conducted at the national level to evaluate the performance of all students in various subject areas. In this study, we use 2013 mathematics data for sixth grade students (11–12 year olds). We also consider the scores earned by the same students when they were in fourth grade in 2011. Based on this data, we build a panel to control for the unobservable characteristics of each individual. The measurements considered for the schools are: type, secondary and tertiary education of the mothers of the students in the class, and socio-economic status (SES). This last measurement is an index composed of the educational level of the parents and household income. These are measurements that allow us to capture the influence on the "institutional mechanisms" referred to in the literature. Although it is frequently difficult to separate out this last theoretical mechanism from the influence of the school context itself (Sharkey and Faber, 2014), in our case, the majority of the students study in schools within the same area in which they live (87.6%). As such, we can refer to problems strictly linked to the lack of provision of educational resources with a certain degree of confidence.

Environment and neighborhood variables

In order to describe the geographic environment, we have used municipality-level data. The measurements considered make reference to the aforementioned theoretical mechanisms. First, "collective socialization processes" of the neighborhood have been measured through unemployment rates in the municipality, which reflects a negative role model. As we indicated above, the local structures of employment produce "collective socialization" in geographic environments. In this sense, neighborhoods with a high unemployment rate could stand in the way of the creation and spread of standards associated with that practice, such as the benefits associated with education (Wilson, 1996). In addition, we have added indicators on the percentage of tertiary education, average household income and the crime rate in the district, which have been highlighted in other studies (Ainsworth, 2010; Miltenburg, 2015). However, we agree that the measurements used in the literature to examine the socialization mechanisms mentioned above are fairly imprecise (Harding, 2011). Second, in order to represent the level of "social cohesion" of the neighborhood, the municipality participation rate in neighborhood organizations is incorporated. This aspect has been widely considered to be an essential element of the aforementioned concept (Schiefer and van der Noll, 2016). Finally, we have included neighborhood location – rural or urban – as a general control.

Economic affluence (average income), unemployment rate, participation in neighborhood meetings, the proportion of inhabitants with complete tertiary education and neighborhood location are calculated using the 2013 CASEN Survey. Data on crimes are obtained from the Crimes with Major Social Impact [Delitos de Mayor Connotación Social] database, which is maintained by the Chilean police force and includes robberies in which violence or intimidation were involved, robberies involving surprise or use of force, theft, assaults, homicides, and rape by area. A dummy variable was built that takes the value 1 if the area forms part of the highest quartile of average crime between 2008 and 2012.

While the 2013 CASEN Survey does not present municipality-level representativeness, analyses of poverty since 2009 show that the estimates obtained directly are consistent with estimates for small areas (Casas-Cordero et al., 2011).

Given that this study seeks to identify variables that represent the geographic area above and beyond the measurements used in the traditional literature, we have added measurements of inequality and polarization of the surroundings of the schools. These variables allow us to analyze the "relative marginalization" at the district level, that is, how the heterogeneity of the geographic area affects educational outcomes.

The measurements of inequality and polarization have been calculated based on a SES index. We base this on a principal component analysis (PCA) that was developed earlier (Valenzuela et al., 2014) which includes three variables: the mother's education, the father's education and household income. The SES variable captures dispersion among households which each variable alone is not capable of identifying because it involves questions that gather information in sections.

The Gini coefficient of the area is used to measure inequality. The polarization measurement is based on Esteban and Ray (2011). This measurement is present in the literature on inequality indicators and seeks to capture differences among individuals. The authors hypothesize that social tensions are not produced by these differences, but are triggered by the concentration of groups constituted by people who are similar to one another. In order to capture this phenomenon, we propose a standardized polarization indicator between 0 and 100.

Formally, an individual located in x feels alienation that grows monotonically in distance with regard to an individual located at y, $|x\text{-}y|$, and thus it is assumed that alienation is reciprocal (Duclos et al., 2004). In order for this alienation to translate into social tension, the individual must feel identified with other members of society. As such, the individual located at x is assumed to feel growing identification in the density around x.

Let α be a parameter that measures the importance of group identification and ρ the distribution of the variable of interest among groups. The measurement of polarization is thus defined as:

$$P(f; \alpha; \beta) = ER(\alpha, \rho) - \beta \cdot \varepsilon(f, \rho)$$

where $ER(\cdot)$ is the polarization function described in Esteban and Ray (1994):

$$ER(\alpha, \rho) = \sum_i \sum_j \pi_i^{1+\alpha} \pi_j |\mu_i - \mu_j|$$

With π_i the proportion of people in group i, and μ_i the value of the variable of interest of group I. Where $\varepsilon(f, \rho)$ is a measurement error and $\beta \in [0, 1]$ is the importance of the error in the polarization measurement. This error is due to the simplification involved when considering the distribution in terms of n groups instead of a continuum.

Given that we want groups with similar socio-economic levels and not necessarily with the exact same income, groups are built around a central value. The number of groups is defined *ex ante* and the size of each group is defined minimizing the measurement error defined as (Esteban et al., 2006):

$$\varepsilon(f, \rho) = G(f) - G(\rho^*)$$

where $G(\cdot)$ is the Gini coefficient, f is the original distribution, and ρ^* is the distribution considering n groups.

Neighborhood scale

It seems logical to think that no fixed geographic limit can capture all of the theoretical mechanisms described in the literature (van Ham and Manley, 2014). In this sense, we agree that instead of thinking about the geographic context that is most adequate for representing what it means to be a neighborhood, the concerns should be focused on how different aspects of available areas operate on different scales (Sampson, 2012; Sharkey and Faber, 2014). In other words, the most appropriate scale should be used to study the research problem identified, based on the specific theory and evidence (Galster, 2008).

In this study, we are aware that using a municipality scale that operates on a broader geographic level will allow us to capture some mechanisms but will obscure others (Andersson and Malmberg, 2015). For instance, mechanisms such as collective socialization and peer effects could also be more difficult to track given that they theoretically operate on a smaller geographic level. However, processes of greater interest for this study such as inequality and polarization can probably be identified in function of broader geographic scales in that they respond to more structural aspects of urban geography.

Based on considerations of relative marginalization processes that are produced by geographic inequalities, we argue that residents construct a social imaginary regarding social stratification not so much based on the notions that they have of the complete city or in function of immediate residential sectors. We believe that the identification of effects associated with their existence requires areas that are adequately large and clearly identifiable enough for differences to take shape and for the residents to be able to notice them and feel affected by them. The geographic level of the district could be an appropriate context in this case.

Sample

The results that we will present correspond to the analysis of 127,020 sixth graders from 4,144 schools in 318 municipalities.[1] The original size of the sample (214,805 students) was reduced based on the following criteria:

(1) Parents who did not answer the corresponding survey (38,002 students);
(2) Students in the sample who did not take the 2011 SIMCE test (23,390 students); and
(3) Schools with fewer than 10 students (7,119 students).

The rest of the observations (19,274 students) are lost because the corresponding districts are not covered by the 2013 CASEN Survey sample.

As Table 1 shows, there are differences between the final sample and the total population of students who took the 2013 SIMCE. In general, we can see that the variables do not present important differences when reducing the sample.

When looking at the SIMCE score, the difference between the original sample and the students that we considered in the final sample is seven SIMCE points (0.14 standard deviations). Given that this difference may not be informative, we included other variables. As we can see, parents' education does not seem to change when reducing the sample. The same happens to the class composition, 4th grade SIMCE score and the proportion living in the same district where they study. There are differences in income of around 50 thousand pesos (US$70) per month, which can be considered small as it is equivalent to 7.2% of the national median (or 5% of the national average). As such, we

Table 1. Change in standardized mean score when reducing sample.

	All 2013 SIMCE Scores	With parents' survey	With 2011 SIMCE	Schools over 10 students	Covered by CASEN 2013
6th grade SIMCE	250.1	250.5	254.6	255.5	256.8
Standardized score	0.00	0.01	0.09	0.11	0.14
Household income (thousands)		493.8	511.5	524.7	543.0
Father's years of education		11.6	11.7	11.9	12.0
Mother's years of education		11.6	11.8	11.9	12.0
Mothers with secondary education in the class		41.9%	41.9%	41.9%	42.0%
Mothers with tertiary education in the class		20.5%	20.6%	20.7%	20.8%
4th grade SIMCE			263.0	264.1	265.2
Living in the same district			87.9%	87.8%	87.6%
Number of observations	214,805	176,803	153,413	146,294	127,020

can deduce that there is no selection bias in the sample used. In practice, this sample represents 87.3% of all municipalities, 55% of all schools and 59% of all students, which means that our results are only representative of that part of the population.

Table 2 presents descriptive statistics for the variables considered. Our results showed that 84.8% of the students stayed in the same school between Grades 4 and 6. Of the remaining 15.2%, over 55% stayed in the same district. In other words, territorial mobility at the school level is low, with over 90% of students remaining in the same area.

One point to consider in Table 2 is that the values that the Gini coefficients take at the municipality level are significantly lower than those known at the national level. This difference is due to a major extent to the fact that inequality in Chile takes place between and not within districts. In other words, these are differences that are produced by the high territorial segregation that exists in the country.

Empirical strategy

In order to measure the importance of the various contexts, we propose a standard production function in which the result is the SIMCE mathematics score of student i in school j and district k. The following lineal production function is proposed:

$$score_{ijk,t} = \alpha + \beta X_{i,t} + \gamma C_{i,t} + \delta S_{j,t} + \eta M_{k,t} + \mu_{i,t} \tag{1}$$

where X, individual characteristics; C, class characteristics; S, school characteristics; and M, the characteristics of the surroundings in which the school is located.

We intend to identify the geographic mechanisms that affect school performance controlling for individual, class and school characteristics. In addition, we use the SIMCE test structure to control for the score obtained by the same student in fourth grade in 2011. This is a contribution to the identification of *neighbourhood effects* in that it controls for the unobserved characteristics at the individual level:

$$score_{ijk,t} = \alpha + \beta X_{i,t} + \gamma C_{i,t} + \delta S_{j,t} + \eta M_{k,t} + \theta score_{ijk,t-1} + \mu_{i,t} \tag{2}$$

Table 2. Descriptive statistics: individual, household, school and neighbourhood.

	Mean/ Proportion	SD	Min	Max
Individual variables				
Outcome variable				
Educational achievement (6th grade Math SIMCE score)	256.8	49.37	112.0	383.0
Predictor variables				
Educational achievement (4th grade Math SIMCE score)	265.2	48.65	106.5	382.2
Gender (1 = boy, 0 = girl)	0.486		0	1
Household variables				
Household socioeconomic status (SES)				
Household income (in thousands)	543.2	569.1	50	2300
Father's years of education (in years)	12.0	3.7	0	22
Mother's years of education (in years)	12.0	3.5	0	22
Cultural capital (books available)				
None (reference)	0.03		0	1
1–9 books	0.24		0	1
10–50 books	0.48		0	1
51–100 books	0.15		0	1
100 and more books	0.10		0	1
School variables				
Type of school				
Public	0.35		0	1
Subsidized private (reference)	0.57		0	1
Paid private	0.08		0	1
School socio-economic status (SES)				
Low SES (reference)	0.06		0	1
Middle-low SES	0.30		0	1
Middle SES	0.38		0	1
High-middle SES	0.18		0	1
High SES	0.08		0	1
Mothers with secondary education in the class (proportion)	0.42	0.02	0.09	0.68
Mothers with tertiary education in the class (proportion)	0.21	0.04	0.11	0.91
Neighborhood variables				
Neighborhood location (1 = rural, 0 = urban)	0.065	0.246	0	1
Collective socialization processes				
Unemployment rate	0.07	0.03	0.00	0.34
Tertiary education (proportion)	0.12	0.89	0	1
Neighborhood affluence (income in thousands)	266.3	151.6	95.6	1110
Neighborhood crime (1 = yes, 0 = no)	0.40	0.49	0	1
Social cohesion				
Neighborhood participation (proportion)	0.05	0.04	0.00	0.34
Relative deprivation and horizontal inequalities				
Neighborhood inequality (Gini index)	17.60	2.60	7.31	25.51
Neighborhood polarization (polarization index)	2.80	0.59	1.31	5.33

The student's score thus depends on the aforementioned variables as well as a set of unobservable variables that are specific to each person. Variables such as skills or lived experiences influence academic performance but are not easily captured so that they can be included as variables. We base our estimates on a lagged dependent variable model and use the fourth grade score because it depends on the same unobservable individual variables as the sixth grade score.

By controlling for the score obtained two years earlier, as can be appreciated in equation (2), we can control for all unobservable variables that are specific to each student and that we could not otherwise capture. This allows us to correct for omitted variables biases which affect both the score obtained in Grade 6 and the independent variables included, biasing the estimators in equation (1). We estimate all of these models using multilevel mixed-effects linear regression.

It is important to note that the lagged variable is not exactly the same dependent variable given that these are tests taken by the same person at two different academic levels. The two assessments have different contents and structure. This reinforces the identification chosen in favor of a fixed effects estimate (Angrist and Pischke, 2009).

This empirical strategy, which control for past outcomes allow us to reduce significantly potential selection bias related to the choice of neighbourhood made by families. If those characteristic are fixed over time and explain school and neighbourhood choice, then the potential bias is reduced when more than one period is used. This topic has received a lot of attention in the literature (Galster, 2008; Nieuwenhuis et al., 2017; van Ham and Manley, 2012).

We also estimated alternative econometric models in order to evaluate the stability of parameters and validity of the main results.[2] First, we estimated the same specification for different subsamples: by school type and for students living and studying in the same or other municipality. Second, we estimated a model adding schools and neighbourhood jointly in the second level, which in practice is adding on the school as a level. The polarization parameter is no longer statistically significant. This outcome may be explained by the large variance within each school, reducing the significance of all variables related to neighbourhood. We argue that this strategy would provide more relevance to the schools rather than the geographical context. In addition, this strategy assumes both contexts having the same meaning. Third, we estimated a model with three levels (individual, school, and municipality), and we split the sample in the same way we did in the first alternative model. Under this approach, the polarization parameter is statistically significant only for students living in other municipalities. These results reinforce the relevance of the neighbourhood in which the school is located. Forth, we include a multiple membership model for school type and municipality as levels, where the polarization parameter does remains significant. Given these comparisons, we believe our model to be a robust characterization of the phenomenon.

Results

This section identifies *neighbourhood effects* on educational outcomes of sixth grade students. The variables were grouped into three contexts of possible influence. The first group considers household characteristics, such as the father's education or household income; the second addresses school characteristics such as socio-economic level or the educational level of the parents of the students in the grade; and the third includes district characteristics such as inequality, crime and unemployment rates. Table 3 shows our estimates.[3]

Table 3. Multilevel estimate of 6th grade SIMCE math scores.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Individual variables (level 1)								
Educational achievement (4th grade score)					0.716***	0.703***	0.716***	0.702***
					(0.004)	(0.004)	(0.004)	(0.004)
Gender (1 = boy, 0 = girl)	0.080***	0.090***	0.080***	0.089***	0.002	0.008*	0.002	0.007
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Household variables (level 1)								
Household income (in million CLP)	0.293***	0.103***	0.293***	0.103***	0.132***	0.044***	0.132***	0.044***
	(0.010)	(0.009)	(0.010)	(0.009)	(0.008)	(0.006)	(0.008)	(0.006)
Mother's years of education (in years)	0.034***	0.019***	0.034***	0.020***	0.012***	0.005***	0.012***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Father's years of education (in years)	0.029***	0.017***	0.029***	0.017***	0.010***	0.005***	0.010***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cultural capital (reference: none)								
1–9 books	0.074***	0.063***	0.074***	0.061***	0.037***	0.032***	0.037***	0.031***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.011)	(0.011)	(0.011)	(0.011)
10–50 books	0.191***	0.150***	0.191***	0.149***	0.066***	0.048***	0.066***	0.047***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.012)	(0.012)	(0.012)	(0.012)
51–100 books	0.302***	0.246***	0.303***	0.245***	0.107***	0.083***	0.107***	0.082***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.012)	(0.012)	(0.012)	(0.012)
100 and more books	0.388***	0.338***	0.388***	0.337***	0.136***	0.117***	0.136***	0.116***
	(0.020)	(0.019)	(0.020)	(0.020)	(0.012)	(0.012)	(0.012)	(0.012)
School variables (level 1)								
Type of school (reference: voucher)								
Public		−0.136***		−0.139***		−0.113***		−0.115***
		(0.020)		(0.021)		(0.013)		(0.013)
Private		−0.017		−0.014		0.029		0.030
		(0.066)		(0.066)		(0.049)		(0.049)
School SES (reference: low SES)								
Middle-low SES		0.118***		0.145***		0.053***		0.067***
		(0.021)		(0.021)		(0.015)		(0.015)

(continued)

Table 3. Continued.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Middle SES		0.335***		0.369***		0.123***		0.141***
		(0.027)		(0.027)		(0.020)		(0.022)
High-middle SES		0.622***		0.656***		0.248***		0.266***
		(0.033)		(0.033)		(0.024)		(0.025)
High SES		0.843***		0.876***		0.323***		0.341***
		(0.071)		(0.071)		(0.054)		(0.054)
Mothers with secondary education in the class (proportion)		−0.366		−0.198		0.368		0.458
		(0.593)		(0.577)		(0.304)		(0.302)
Mothers with tertiary education in the class (proportion)		0.541**		0.542**		−0.140		−0.139
		(0.271)		(0.263)		(0.161)		(0.160)
Neighborhood variables (level 2)								
Neighborhood location (1 = rural, 0 = urban)			−0.006	0.133***			0.003	0.070***
			(0.034)	(0.032)			(0.018)	(0.020)
Unemployment rate			−0.086	0.037			−0.263	−0.210
			(0.257)	(0.285)			(0.171)	(0.172)
Tertiary education (proportion)			0.988**	0.191			0.371	−0.041
			(0.432)	(0.461)			(0.261)	(0.255)
Neighborhood affluence (income in million pesos)			−0.285	−0.093			−0.102	0.036
			(0.267)	(0.291)			(0.154)	(0.149)
Neighborhood crime (1 = yes, 0 = no)			−0.036	−0.047			−0.009	−0.012
			(0.028)	(0.030)			(0.017)	(0.017)
Neighborhood participation (proportion)			0.294	0.721***			0.082	0.292*
			(0.243)	(0.267)			(0.144)	(0.149)
Neighborhood inequality (Gini index)			0.033***	0.039***			0.008	0.011*
			(0.011)	(0.011)			(0.007)	(0.007)

(continued)

Table 3. Continued.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Neighborhood polarization (polarization index)			−0.095**	−0.114***			−0.039	−0.051**
			(0.040)	(0.044)			(0.024)	(0.024)
Constant	−1.026***	−0.747***	−1.374***	−1.281***	−0.499***	−0.484***	−0.524***	−0.609***
	(0.027)	(0.207)	(0.123)	(0.244)	(0.017)	(0.106)	(0.075)	(0.128)
Between-municipality variance	0.038***	0.047***	0.035***	0.04***	0.013***	0.014***	0.013***	0.013***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Within-municipality variance	0.794***	0.763***	0.794***	0.762***	0.383***	0.375***	0.383***	0.375***
	(0.007)	(0.006)	(0.007)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	127,020	127,020	127,020	127,020	127,020	127,020	127,020	127,020
Number of groups	318	318	318	318	318	318	318	318

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

Models 1 through 4 do not include the SIMCE score of the student in fourth grade, while Models 5 through 8 do. Including this variable reduces the coefficients in absolute value, which suggests that the measurements capture both a direct effect and an indirect effect through the individual characteristics. We also observe the reduction of some coefficients, though the statistical significance is maintained for nearly all of the household variables and school characteristics.

Model 1 shows the effects of the individual and household characteristics. The analysis indicates that men's scores are on average 0.08 standard deviations higher than women's scores in mathematics. One can also see that variables regarding families' SES are shown as significant predictors. Specifically, both economic capital and the parents' education are positively related to an increase in the SIMCE score. An additional year of schooling for the father has an impact equivalent to an increase of just over US$140. In addition, the results show that cultural capital (available books) in the household positively and increasingly affects children's performance.

When we incorporated the school context effects (Model 2), we found that attending public schools implies a lower score by 0.136 standard deviations compared to subsidized private schools. We also report that SES of schools has a positive impact on SIMCE scores and its effect tends to increase in the upper strata. By contrast, we did not find significant effects related to the educational level of the mothers at the class and regarding the difference between subsidized and paid private schools. Generally, the school composition impacts all effects related to the household context, especially SES.

Model 3 incorporates the effects of the school's geographic area excluding characteristics of its composition. The initial findings show positive and highly significant effects on academic performance in measures of tertiary education and economic inequalities (Gini index). By contrast, negative effects associated with socio-economic polarization were observed. In addition, local participation, unemployment and districts that are rural do not seem to be significant predictors. However, when all of the levels are included (Model 4), the rural context becomes a positive and significant predictor, and the same happens to local participation, while education loses significance.

The variables that represent the composition of the school show positive and significant results with the exception of the educational level of the mothers in the class (tertiary education loses significance with panel data). The school's SES has a positive and increasing effect on the children's SIMCE scores. For example, a school with a high SES shows an impact of 0.34 standard deviations greater than a school with a low level and 0.14 standard deviations more than a school with a medium level. Paid private schools have the greatest relative impact on the students' score followed by subsidized private schools and public schools. Voucher schools and public schools show statistical differences in mathematics scores, with the latter having 0.12 standard deviations less than the former.

When the student's earlier SIMCE score is included as an independent variable, the geographic context measurements show a more heterogeneous response than the household and school characteristics. Specifically, municipality-level inequality loses almost all significance (p-value of 0.094) and its coefficient is reduced to one-third of its previous value. The other variables move along the same line.

When we analyze Models 5–8, we can see the influence of different sets of variables, particularly the relationship between household characteristics and the rest of the contexts. The household variables are robust for the different estimates and the main differences occur between household and school contexts. Specifically, the composition of the school considerably reduces the effect of the household variables, mainly the impact of monetary income on children's SIMCE score.

Model 8 shows the effects of including all of the variables and thus presents the authors' preferred estimate. In regard to the household context, parents' education has a positive impact that is marginally lower than that of the mother's education. Cultural capital also has a positive effect, as does household income. For example, reporting that the family owns 100 or more books has an effect on the score that is 3.7 times greater than reporting ownership of between 1 and 9. In comparative terms, an increase in both parents' education by one year has an effect that is equivalent to an increase in monthly household income of almost US$360.

In regard to the geographic context, district inequality (Gini index) loses almost all significance when controlling for the student's past performance. However, the measurement of polarization remains significant and has a negative effect in all models. This suggests that it is not the differences or gaps that affect students' educational performance, but identification with a socio-economic group in relation or opposition to another. In addition, both unemployment and the crime rate have a negative effect, while local organization presents a positive and significant impact on academic performance (p-value of 0.051). Moving from lower neighborhood participation (0.15%) to median participation (3.4%) has an effect on performance that is equivalent to each parent increasing their education by one year or the household increasing its total monthly income by US$308.

In regard to the different impacts observed for school and neighborhood variables, we see that the influence of the former variables increases marginally (in absolute value) once the latter are included, while neighborhood variables show heterogeneous changes when school variables are included.

At the school level, the main predictor is the school's socio-economic level, while at the municipality level it seems to be polarization. It is not possible to make a direct comparison because that would require knowing the costs related to decreasing the level of polarization of the municipality or changing the school's socio-economic level. But as a reference, moving from a middle SES school to a high SES (an increase of 0.2 standard deviations in school performance) would be equivalent to reducing polarization by 3.9 percentage points (notice that average polarization is 2.8).

In order to understand what that effects represent, it is necessary to analyze the variation of polarization and its effect on school performance. While the variable shows little variance between the communities, the effect on school performance is important. For example, moving from the lowest polarization observed to the median (from 1.3 to 2.7 on a scale of 0 to 100) is equivalent to a 0.07 standard deviations decrease in mathematics scores or a reduction of 24.4% in citizen participation; to reducing total family income by US$2300 per month; and to each parent increasing their education by over 6.5 years; or moving the school from a medium-high SES to a high level. In summary, these are findings that represent negative effects related to acute social inequalities that take place in Chilean districts. We theorize that the magnitude of the repercussions could represent the consequences associated with a historical context of accumulation and persistence of inequality that has affected Chile for a long time.

Discussion

This article proposed researching possible *neighbourhood effects* on the educational outcomes of Chilean sixth graders. Based on panel data and controlling for previous individual performance, school context, and home characteristics, we have found unique evidence for the Latin American context. The findings show the influence of acute social inequalities and neighborhood participation at the district level.

The results obtained support the traditional hypothesis on *neighbourhood effects*, though specifically for the school surroundings. In other words, disadvantaged communities are associated with lower academic outcomes, even considering individual characteristics. This is innovative evidence that supports the findings reported for the area of residence (Owens, 2010). Briefly, we observe the negative impact of urban spaces with more polarization, though at the same time we note the positive influence of neighborhood participation, as social cohesion mechanism. Of these measurements, socio-economic polarization had the strongest link to performance. At the same time, it is important to note that the measures that represent collective socialization processes of children (unemployment, average income, educational level and crime rate) do not appear to significant predictors. A plausible explanation that we extract from the literature is that mechanisms probably require smaller geographic scales to be clearly identified (Andersson and Malmberg, 2015).

The most interesting results of this study provide evidence to sustain the claim that inequalities observed in geographic areas have a negative impact on children's educational achievement. One way of interpreting this evidence is to posit the presence of what we have called relative marginalization (Cutler and Glaeser, 1997). This theoretical mechanism would allow us to suggest that children are aware of the observable socio-economic differences in the geographic space and that this can lead to behaviors associated with devaluating norms (Bernburg et al., 2009). It is also possible that children are subjected to the effects of their surroundings without being explicitly conscious of social inequities that surround them. We report a specific form of social inequality considering theoretical contributions from economics (Stewart, 2008). This is a matter of acute horizontal economic inequity that we have represented with a measurement of polarization (Esteban and Ray, 1994). Based on this, we suggest that the alienation perceived by disadvantaged groups given the antagonistic socio-economic conditions that are observed in the geographic space produces tensions and conflicts that could be associated with unfavorable academic outcomes. This could have a complementary interpretation given that dominant social discourse that promotes meritocracy in Chile – equality of opportunities, value of education and individual effort – stands in stark contrast to a profoundly unequal reality characterized by limited social mobility (Contreras et al., 2014; Núñez and Miranda, 2010). In short, it is a country in which competition and constant comparison to others is promoted, which seems paradoxical with the existing social reproduction.

As the literature suggests, we theorize that the effects associated with local participation are related to the neighborhood's collective efficacy. In this regard, it has been said that municipalities that show greater social organization are better able to implement social controls and thus ensure compliance with norms associated with the value of education (Ainsworth, 2002; Sampson et al., 2002). In addition, one could imagine that geographic areas with more organization have greater impact on local policies, such as the improvement of educational institutional structure. However, due to the magnitude that this effect displays, we suggest that it may also reflect the influence of communities that are constitutive of social cohesion that are usually associated with social participation practices. These include local networks, trust among residents, and a sense of belonging to the neighborhood.

Conclusions

Our findings allow us to highlight some contributions and make theoretical and methodological suggestions. First, we underscore the importance of incorporating different contexts simultaneously in order to avoid the omitted variable bias and capture

effects that would otherwise be underestimated (Cook et al., 2002; Owens, 2010; Sykes and Musterd, 2011). In our study, we can observe substantial differences in this regard. For example, the impact of household variables decreases while the effects of neighborhood location become significant when the context of the school is considered. Second, we agree about the value of using panel data to identify *neighbourhood effects* (Musterd et al., 2012; Nieuwenhuis and Hooimeijer, 2016). Our results show differences in the neighborhood context and at the school level. For example, the positive effect of the gender of the students and tertiary educational level of the mothers is cancelled out, while the statistical significance of the impact of inequalities and participation in the area decreases. Third, in regard to the need to rethink theoretical mechanisms associated with *neighbourhood effects* (van Ham and Manley, 2012; van Ham et al., 2012), we incorporate a form of social cohesion related to participation in local institutions. This mechanism serves as a positive predictor for academic performance. In addition, we make distinctions about the mechanism of relative marginalization in that it suggests differentiating between inequality and geographic polarization. In short, while our findings provide evidence on *neighbourhood effects*, they also suggest that the criticism regarding the validity of the findings reported based on transversal data should be a main concern in the development of future discussions (van Ham et al., 2014).

A final aspect to be highlighted is related to the criticisms that have been offered from urban Marxist theory (López-Morales, 2015; Slater, 2013). Specifically, the evidence that we present suggests that although the central hypothesis associated with *neighbourhood effects* cannot easily be omitted, it must be tempered using mechanisms that capture geographic inequalities. We believe that theoretical tools such as relative marginalization can serve as useful bridges between the two approaches.

In regard to the provision of institutional resources in the geographic areas through the resources that municipalities have at their disposal, the results are useful for representing how discriminatory and exclusive reforms that were implemented in the early 1980s during the dictatorship have had a dramatic impact on the spatial segregation of the population. We agree with Soja (2010), who underscores the fact that decisions that contribute to exclusion at the institutional level give form to the unequal structure of opportunities that is configured in geographic spaces. In practice, we speak of policies that have generated a spatial injustice that reproduces the structures of privilege of the most favored groups in the nation.

Considering the possible measures that could serve as vehicles for reducing socio-spatial inequalities and their unique expression in the fragmentation of educational results based on geographic areas, we propose generating legal mechanisms that would allow the population to overcome the administrative division that municipalities represent in the allocation of resources to schools. The distribution of resources utilized thus far has not been an efficient means of reducing the existing gaps.

Finally, this article has a series of limitations that could be addressed in future research. First, we agree that the research on neighbourhood effects requires greater reflection on how theoretical mechanisms, measurements and methods we use are effectively aligned with the social processes in which we are interested (Sharkey and Faber, 2014). While there are some interesting conceptual mechanisms, there is little clarity regarding how the theoretical mechanisms formulated, especially those related to the socialization of children, can link the inequality of geographic contexts to the diverse individual results, particularly educational results (Harding, 2011). Furthermore, given that the effects that have habitually been defined as differentiated from the various social contexts (individual, household, school) are closely linked to each other (Sharkey and Faber, 2014), it is necessary to think about a broader and more reflexive referential framework that contains them.

Second, we also recognize that is almost impossible to measure all variables explaining choice of neighbourhood and schools (Galster, 2008; Nieuwenhuis et al., 2017). However, the estimated model (multilevel with lagged dependent variable) allows us to reduce the potential bias related to endogenous variables. Furthermore, the endogeneity of neighbourhood is a more significant problem in societies where individuals have the freedom to choose where to live (see van Ham and Manley, 2010). Although the freedom to choose a place where to live presents a theoretical issue, the evidence indicates that this type of "freedom" is available only for high-income families in Chile. Unlike developed countries where we observe a more equal income distribution and less segregated cities, in a country like Chile better educational outcomes are available in private paid schools, which are quite expensive and located in highly segregated neighbourhoods (Valenzuela et al., 2014). The Chilean population attending private paid education is only about 7%. The vast majority of Chilean families are not rich enough to move freely to better neighbourhoods looking for a better education. Additionally, even if they were able to move, private and voucher are able to reject students, limiting family options (Contreras et al., 2010), so that school's segregation is greater than neighbourhood segregation. The current chances for most Chilean families to jointly choose neighbourhoods and, to some extent, schools are significantly limited (Sanhueza and Larranaga, 2008).

In addition, we agree that there is a need to test and compare the theoretical mechanisms on different geographic scales. For example, it is possible that the reported effect on polarization will disappear on smaller geographic scales. Also, more in-depth work could be conducted on the effects of social cohesion at the vicinity level on educational outcomes based on findings reported on local participation. Issues such as social trust, social interactions and a sense of belonging to the district could be important for understanding and revitalizing the study of the effects in general and on academic outcomes in particular. Moreover, even in empirical strategy as we used, it is difficult to evaluate causality of *neighbourhood effects*. As it has been pointed out earlier, the socio-economic affluence of the neighborhood is itself determined by the SES of each resident (Miltenburg, 2015). So, *neighbourhood effects* provide an additional reinforcement to the persistence of structural inequality of Chilean context.

Notes

1. Chile has 364 districts (*comunas*), the smallest administrative division in the country. The districts are managed by municipalities governed by a mayor and 6 to 10 councilors.
2. These results are available upon request.
3. We tested for the possibility of multicollinearity between the variables in our model. This test shows low levels of multicollinearity, and it is mainly between high SES schools and high cultural capital in the household. As such, when effects disappear when including new variables, it is likely due to better identification of transmission channels rather than overfitting our model.

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