"RESIDENTIAL SEGREGATION AND THE GEOGRAPHY OF OPPORTUNITIES: SPATIAL DEPENDENCE AND SPATIAL HETEROGENEITY IN EDUCATION: A CASE STUDY OF SANTIAGO"[1]

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This paper analyzes the consequences of socioeconomic residential segregation on children's educational outcomes. The analysis focuses on the city of Santiago, Chile, using the Chilean Census of 2002 in combination with individual and school data from the national standardized test. Multilevel and spatial models are implemented with the aim of analyzing the problems of spatial heterogeneity and spatial dependence in education. The results demonstrate that spatial socioeconomic segregation negatively affects educational outcomes beyond and above household and school poverty. This negative effect remains after controlling for the characteristics of the school. In addition, the results change with the scale of analysis: the effect of segregation on educational outcomes tends to be more negative when segregation is measured at a small scale rather than a large one. The contrary applies for the effects of the concentration of wealth. Spatial models provide evidence that there are educational benefits that trickle down from a school to schools within its vicinity.

[1] This paper will be presented at the 2006 PAA Conference. Please do not quote without the permission of the author. For suggestions or remarks e-mail c.a.flores@mail.utexas.edu.

I. Introduction

Santiago, as many Latin American cities, shows high levels of socioeconomic residential segregation (Sabatini, 2003). Poor population form large homogeneous clusters of households where opportunities are scarce and out-of-the-way. Similarly, despite the introduction in 1980 of a voucher that allows all Chilean families to choose schools without any spatial restriction, the educational system is highly segregated. There is, in fact, a three-tier educational system with three main providers of public, private subsidized and private non-subsidized education. In practice, not all families are able to use their ability to choose as a way to compensate for the negative effects of concentration of poverty in their residential neighborhoods. Part of the reason is simple and refers to the distribution of opportunities: schools for the poor are located in poor neighborhoods whereas schools for the rich are located where the elites reside. Given the large scale of segregation, these schools and their respective students are located far away in opposite parts of the city. On the other hand, middle class -private subsidized- schools are to some extent more evenly spread along the city. However, they have long waiting lists and, due to the nature of the subsidy- tend to recruit the best students they can. In other words, school's "capture" behavior prevent he poorest children from accessing these schools. This situation generates what Kein (2004) calls the worse spatial mismatch of all: an uneven geography of education opportunities that affects life chances later in life.

During the last decade, an important number of gated communities for medium and high income households have been built in poor neighborhoods in the city's peripheries. Gated communities bring about a new phenomenon by which spatial distances between the rich and the poor tend to decrease. In other words, gated communities decrease the scale of segregation. High income population attracts infrastructure, investment and services to these areas that were previously deprived. As a result, a number of schools have been built in these neighborhoods in order to meet the increasing demand for education. Taking this new trend, this paper wonders about the impact of the increasing spatial propinquity between socio-economic groups on poor children's educational outcomes.

Thus, the problem can be analytically separated into two spatial processes: spatial heterogeneity and spatial spillovers. Spatial Heterogeneity refers to the fact that the effect of a given set of explanatory variables on a dependent variable might vary from place to place. Hypothetically, the spatial variability of the coefficients in the education production function can be explained – in part- by the level of segregation in the neighborhood. In other words, spatial heterogeneity relates to the hypothesis of "neighborhood effects" on educational outcomes. It refers to the hypothesis that children living and/or attending schools located in segregated experience collective and institutional socialization processes that do not encourage educational achievement. These children are also more exposed to negative peer effects. The negative effects of the neighborhood are mediated by the effects of parents, adults in the neighborhood and institutions and their peers (Mayer, 1997, 2002; Brook-Gunn, 1993). Neighborhood effects are analyzed using multi-level models that separate the neighborhood effects coming from the school neighborhood at different scales. GIS are critical since they allow matching different levels of geo-referenced data: individuals' socioeconomic characteristics and educational outcomes,

schools' socioeconomic characteristics and educational outcomes, and neighborhoods characteristics and level of segregation.

It is important keeping in mind that, in a pro- choice system where children can move from one neighborhood to another, "neighborhood effects" refer to both, the effects of residing in a particular neighborhood and the effects of attending a school that is located in a particular neighborhood that might or might not be the same. However, it is true for the poor that school and residential segregation concur. In this case, the "schools for the poor (rich)" are spatially concentrated where the poor (rich) live. In such a case, children attending schools located in segregated neighborhoods will not benefit from the educational processes taking place in a nearby school that is educationally better off (Bauder, 2000), simply because there are not schools like that around. Thus, due to the nature of the educational system, we use two sets of hierarchical models modeling the education production function.[2] The first model approximates the spatial heterogeneity measuring small scale segregation, whereas the second set gives count of the spatial heterogeneity considering large scale segregation. Both models are evaluated and compared.

According to the first law of geography "everything is related to everything else but near things are more related to distant things" (Tobler, 1970 p.234) meaning that things in one place depend upon things in places nearby. The first law of geography states that spatial dependence is the rule rather than the exception (Anselin and Bera, 1998, p. 240); as such, accounting for the correlation of observations closely located in space is as important as dealing with other common data-related problems such as time auto-correlation in panel data and heteroskedasticity in cross section data. Technically, spatial dependence is a property of joint (multivariate) density functions and as such, it is difficult –almost impossible- to verify in practice. Spatial autocorrelation -as a moment of the joint distribution- emerges as the weak but more manageable approach –it can be estimated and tested- to tackle the problem of spatial dependence (Anselin and Bera, 1998).

There are two main reasons explaining spatial autocorrelation. The main one is that spatial proximity affects behavior due to exposure –consequences of behavior in spatial unit "i" on behavior on adjacent spatial unit "j"- and diffusion –the effects of antecedent conditions in unit "i" on behavior in adjacent unit "j" (Morenoff et al, 2001). Households, for example, may change its school choices, depending on the education- market conditions in the neighborhood compared to other neighborhoods and on the distance to these neighborhoods. The second reason is that data collection of observations in spatial units might reflect measurement error. This is the case when the administrative boundaries for collecting information - the arbitrary delineation of space

[2] Most likely, the school and the household will be located in different neighborhoods; moreover, half of the time they will be located in different districts: 48% of the daily study- related travels in primary education are between districts. In the city of Santiago, the average distance between the household and the school among children in primary education is 1.13 km or around 0.7 miles (Republica de Chile, Ministerio de Planificación y Cooperación, 1998. Diagnostico y Recopilación de Información de Educación bajo la Perspectiva del Transporte. Santiago-Chile). Thus, since children live in one place and most likely study in another, the analysis of the neighborhood effects need to be separated. Since there is no available data in order to separate effects, I measure segregation using different scales.

into the units we call neighborhoods- do not accurately reflect the nature of the underlying process we are trying to measure (Morenoff et al, 2001).

Spatial spillovers can be defined as the benefits that trickle down from a source to factors within its vicinity. In a sense, spillovers are a direct consequence of the phenomenon of spatial dependence inasmuch as they can be understood as spatial externalities enabled by a spatial autocorrelation process. In this paper I test for spatial autocorrelation of educational outcomes aggregated at the school level. In other words, we check whether aggregated educational outcomes in a school are correlated with the aggregated educational outcomes in schools nearby.

The next section gives a brief description of the Chilean educational system. Then I outline the main literature connecting segregation and educational outcomes. Section 4 describes data and methods and results are summarized in sections 5 and 6. I finalize with the main conclusions of the study.

II. Chilean Educational System

Chile is one of the few countries in implementing a generalized educational voucher system inspired by Milton Friedman (1955, 1962). Since the educational reform in the early 80s, every Chilean boy and every Chilean girl –regardless his or her socioeconomic status- has the right to use a voucher in any of the school in the system. What is more, the voucher is actually used by almost 90% of the children.

The educational voucher generates a pro- choice educational system that seeks to increase the variety of alternatives available to the families. As argued by Friedman (1955), the main source of formal education should be the private sector, which is assumed to be superior in terms of quality and efficiency. The voucher seeks to give equality of opportunities to all children to access to this type of education, regardless their individual and household characteristics.[3] On the other hand, while neither the resources nor the students are guaranteed, the schools need "to "compete" for financial resources. Theoretically, these schools behave as businesses and have incentives to attract the ideal number of students and their characteristics, the ones maximize the use of resources and that increases the school's reputation as supplier. As a result, children and families end up "sorted" in the different schools according to their preferences as consumers. In addition, since in the system of vouchers the money "follows the child" to the school he/she attends, the latent threat of consumer "exit" (Hirschman, 1970), the schools would be forced to maximize the quality of education for if to assure the desired level of enrolment and therefore funds. [4]

[3] The State provides each school -publicly or private subsidized- a Unit of School Subsidy (USE) per pupil per month. The USE varies according to certain considerations of supply and educational level-pre-school, primary, secondary, etc. - and extension of day - partial or complete - but it does not consider individual variables such as socioeconomic status or level of human capital of the child.

[4] The USE is provided each month to the schools depending on the average attendance on the three previous months. This method of trespassing funds provides incentives to the schools to minimize –and under declare- truancy and dropout

When attracting a mass of suppliers from the private sector, the educational reform generates a threefold system of educational provision. On the one hand, the local governments or municipalities provide public education. On the other hand, the private sector provides education in two modalities: subsidized education and private non subsidized education. [5]. The latter, are the schools opting out from the voucher system. This sector is financed exclusively via private investment. In what follows, I will name these schools public, private subsidized and private not subsidized schools respectively.

In its design, the educational subsidy is aimed at generating equal conditions for competition (Matte and Sancho, 1991). In practice, the student voucher is of equal amount to all children, enrolling either private or public schools. The educational authorities of the 80s expected that both public and private suppliers would act rationally and that in the competition process, the quality of the education would increase in all types of schools. In this scenario, families would sort themselves along different types from schools according to their preferences. Nevertheless, the evidence shows that the socioeconomic status of the household is significantly related to the type of school the children attend. Table 1 shows that, in 2002, the majority of low SES children attend public schools whereas most of the medium class children attend private subsidized schools. Similarly, 97% of children of high SES choose to resign the benefit of the subsidy attending non subsidized private schools.

TABLE 1: ENROLMENT, SOCIOECONOMIC STATUS AND TYPE OF SCHOOL, 2002.

Type of School	**Socioeconomic Status**					
	Low		**Medium**		**High**	**Total**
	A	B	C	D	E	
Public	75.0	76.2	32.0	14.8	…	39.7
Private Subsidized	25.0	23.8	68.0	78.8	2.8	48.9
Private Non- Subsidized	…	…	…	6.4	97.2	11.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: own preparation based on SIMCE, 2002. Percentage corresponds to 4th grade children actually taking the test in the Metropolitan Region of Santiago.

The socioeconomic segregation of the educational system becomes evident when we observe that there are no children of high SES using the voucher in a public school and that less than 3% of them use the voucher in a private subsidized school. At the same time, not a single child of low or even medium SES (group C) can afford to resign the voucher. Thus, it is not unexpected that the educational results obtained through the System of Measurement of the Quality of Education (SIMCE), show a clear gap of outcomes between types of schools. Table 2 shows that average 4th grade's test results is public schools are considerably lower than he observed in private subsidized schools. In 2002, test results in public schools are almost 8 percentage points under

[5] Among private subsidized schools, there are those financed exclusively by the subsidy (voucher or USE) and those schools under the system of "shared financing" where the school us able to collect a small quota from the parents. In 1999, the latter represented near one half of the subsidized private schools. It is worth noting that the system of shared financing also has contributed to the segmentation of the educational system. Parents who cannot finance this quota remain either in public or in private subsidized schools that are free of charge.

the national average, while the school performance in the private non- subsidized schools is almost 16% higher.

TABLE 2: ENROLMENT, SIMCE 4º GRADE PER TYPE OF SCHOOL, 2002.

Type of School	Enrolment	SIMCE	
Public	39.7	231	92.1
Private Subsidized	48.9	252	100.5
Private Non- Subsidized	11.4	291	115.9
Total	100.0	250	100

Source: own preparation based on SIMCE, 2002. Percentage corresponds to 4th grade children actually taking the test in the Metropolitan Region of Santiago. [6]

In the context of the voucher system, the ability of parents "to choose" the school for their children is extremely relevant. In theory, there are no restrictions to the range of alternatives but the decision of the school to receive (opt- in) or not to receive (opt- out) the financial resources coming from the voucher. [7]

In spatial terms, when choosing education, families can move freely from one district or neighborhood to another. In this context –unlike in the USA- the spatial distribution of schools or geography of educational opportunities becomes theoretically secondary. The fact that certain district does not have a sound educational supply is not necessarily relevant since parents are allowed to choose schools outside the limits of the neighborhood.[8]

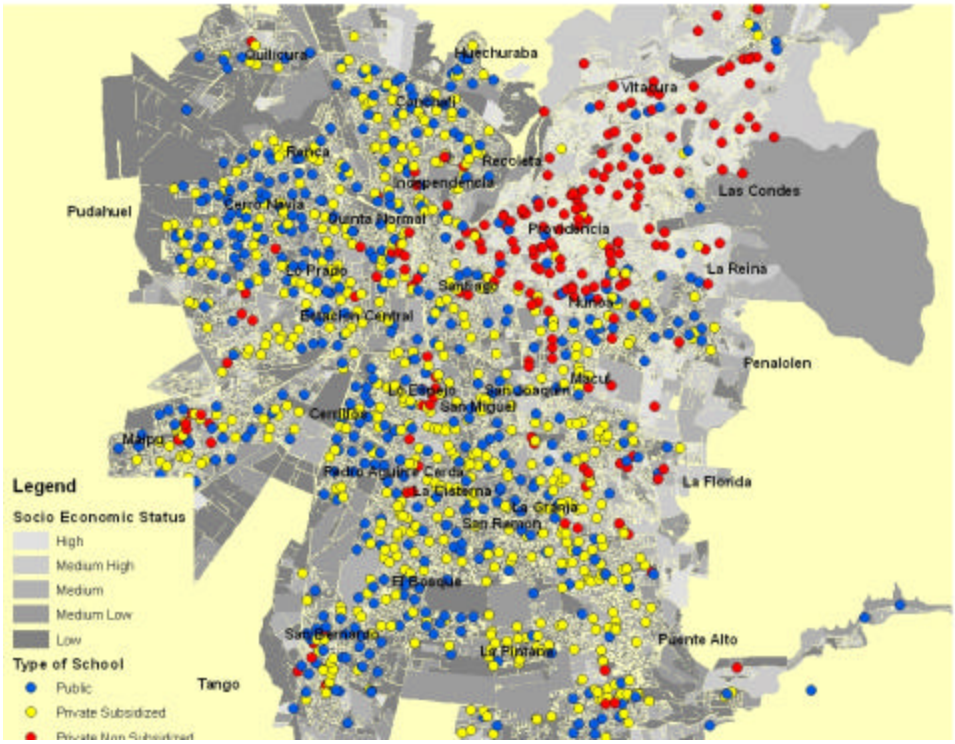
In practice however, the geography of educational opportunities becomes an extremely important restriction. Map 1 below shows the distribution of the population across Santiago's blocks according to their socioeconomic status. The lighter the color the higher the block's average SES. Zones with High SES tend to be located in the north eastern cone whereas poor zones in dark color- tend to concentrate towards the mainly in the municipalities of Renca and Cerro Navia in the northwest and La Pintana in the south. Similarly, the educational supply is spatially segregated. Red dots represent private non subsidized schools which are located mainly in the places where population of high and medium-high SES reside. Private subsidized and public schools –yellow and blue dots respectively- seem to be more homogenously distributed in space. There are some zones –where the very poor reside- where there are mostly public schools and almost no private education supply.

[6] It is important to emphasize that probably many establishments seek "to "inflate" the test results through "hiding" under-achievers. It is likely therefore, that the gap is somehow overestimated, since it is more likely that a school under the logic of competition – private subsidized – will leave underachievers out of the test, whereas public schools -that do not need to compete for financing- are less likely to do so.

[7] This restriction applies only to private schools since public schools are forced to participate in the voucher system.

[8] An interesting point of comparison is the North American educational system, where by general rule the children are restricted to the public schools inside the school district corresponding to their residence. In a system as such, "… school segregation and the residential segregation are inextricably related" (Denton, 1996 p. 795) while school segregation is the logical consequence of the residential segregation (Nechyba, 2003). In the case of a "pro - choice" educational system, where there are no geographical restrictions, the relation between school segregation and residential segregation becomes less evident.

MAP 1: SANTIAGO: POPULATION'S SOCIOECONOMIC STATUS AND SCHOOLS



In spite of the relatively even distribution of private subsidized and public schools in the different zones of the city of Santiago, there is a clear socioeconomic sorting of families between these two types of schools. The "capture" behavior of the private subsidized schools prevents that all the families have the same ability to choose a school, which generates a sorting of families according to their socioeconomic status.[9]

Those families that cannot choose or cannot afford to mobilize from one district to another are restricted to the available local supply. In this sense, the model of market education provision is "geographically naive and therefore socially regressive "(Pacione, 1997), in the sense that does not solve the difficulties faced by the inhabitants of segregated zones. These difficulties are related to both the individual and household characteristics and the characteristics of the space in which they live. On the one hand, poor children generally start with a low human and cultural capital, which implies that the cost of educating these children is relatively higher. On the other hand, since the geography of opportunities is related to the socioeconomic status of the area, the inability to carry out the right to "choose" is closely related to the level of residential segregation of the districts where the poor reside. Besides, households in segregated areas are labeled to have a low social capital which increases even more the cost of to educate the children of these

[9] In the Chilean system, private subsidized schools are legally enabled to use mechanisms of students' selection, more commonly, aptitude tests. This capacity is legally prohibited among public schools that must accept every child wanting to enroll. The "capture" behavior refers to the use of socioeconomic variables or proxies in the process of students' selection.

households. [10] This means that the net subsidy for poor children in segregated zones is less than the net subsidy or voucher for children of medium SES that possess higher human, cultural and/or social capital (Sapelli, 2002). In consequence, poor families in segregated zones, cannot use their right to choose a school because they are identified by the education market as "not - desirable" members.

Being poor and –in addition- residing a segregated area represents a double disadvantage for education opportunities. On the one hand, individual and collective poverty signal a risk in the education market. Schools that act rationally have incentives to filter these children out, thus limiting these families' ability to choose. On the other hand, low social and human capital associated to the collective and individual poverty negatively affects the conditions of "educability" of children (Lopez, N. 2005), thus directly affecting the educational results. Next, I summarize the main theories sustaining the relation between residential segregation residential or collective poverty and early development in general and educational results in particular.

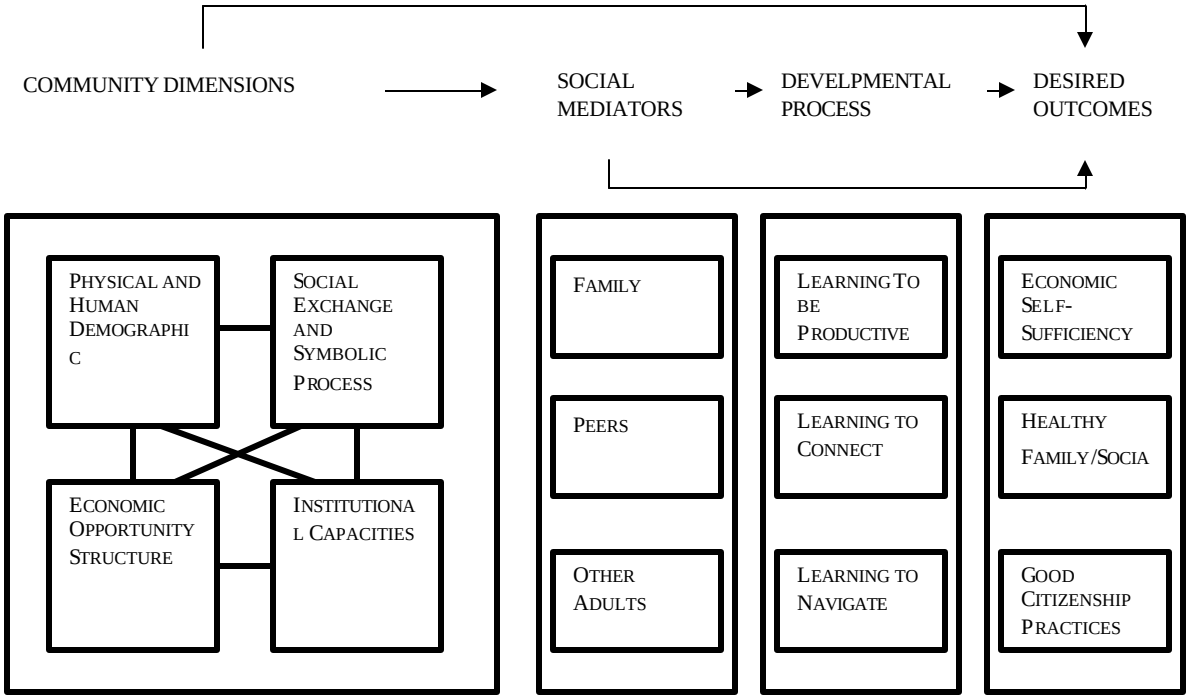
[10] A low initial human and social capital relates to the low educational level of the parents. A low social capital in the household diminishes the "educability" of the children (Lopez, N. 2005) due to the incongruence of the processes of collective socialization and to the lack of children efficiency (Sampson 1997, Coleman 1996, Jenks and Mayer 1990).

III. Residential Segregation and Educational Outcomes

Educational outcomes are affected by individual characteristics and by certain elements that characterize the proximal and distal contexts in which children live[11]. Ecological models of children development (Bronfrenbrenner, 1986) argues that development occur within context. Thus, individuals cannot be studied without considering the context in which he or she operates. In practice, however, research has focused mostly on the most proximal environments such as school, family and peers whilst the neighborhood context has been set aside (Brooks- Gunn et. al, 1993).

Connell et al (1995 p.97-108) develop an analytical framework that positions the neighborhood effect in relation to household and individual effects in children's desired outcomes.

FIGURE 1: NEIGHBORHOOD EFFECTS ON CHILDREN'S DEVELOPMENT: COMPONENTS OF CONCEPTUAL FRAMEWORK



Source: Connell et al (1995 p. 96)

[11] On the lines of Toennies's (1855-1936) "gemeinschaft- gesellschaft" categories that distinguish primitive communities from modern industrial societies, some authors (Warren, 1975) assert that the neighborhoods are less and less important since the tight bonds and face to face relationships have been replaced by functional impersonal business- type interactions. Other authors (Sampson et. al 1997, Brooks-Gunn 1993) argue that regardless the type of interaction they trigger, space –and neighborhoods- are still significant predictors of children development and outcomes. In this sense, it is important to recognize that modern spaces generate different types of ties or social capital that affect children development and educational outcomes (Sampson et al, 1999)

According to Connell's model, there are four features of the neighborhood context that influence children's development in general and educational outcomes in particular. These elements are the physical conditions and demographic characteristics, the economic, racial, educational and social characteristics of the residents, the economic opportunity structure, social exchange and symbolic processes and the institutional capacities of the community. Four elements or micro-systems (Bronfrenbrenner, 1986 p. 724) mediate community factors and youth development: the family, peers and other adults and institutions in the neighborhood. The developmental process itself also mediates community effects on children's desired outcomes.

Building on this framework, two groups of models explain neighborhood effects on children development and educational attainment. The firs group sustains that concentration of poverty has negative effects on educational outcomes whereas the second hypothesis suggests that socioeconomic homogeneity is actually positive for education.

The theories arguing that concentration of poverty is detrimental for education highlight the effects of peers, adults and institutions on children's development. The "epidemic" hypothesis asserts that one of the most important determinants of children's behavior and outcomes is peers influence. (Jenks & Mayer 1990, p.112). Deprived neighborhoods concentrate problems of contagious "bad" behavior among children; thus, concentration of poverty means low educational outcomes due to such contagion.

Models of Collective Socialization assert that adults in a neighborhood influence youth who are not their children (Jenks and Mayer, 1990 p. 114, Sampson et. al 1999 p.635). Isolation and segregation bring about joblessness among adults (Wilson, 1987) which generates a poor system of concrete expectations and goals. Children that grow in such a system do not learn the culture of work. Intergenerational closure or the degree to which adults and children in the community are linked to one another (Sampson et al 1999, p.635) is also important. Neighborhood's social capital (Coleman, 1990) [12] explains and sustains collective efficiency for children[13].whilst "… concentrated disadvantage […] is associated with sharply lower expectations for shared child control" (Sampson et al, 1999 p.633).

Finally, the literature refers to the models of institutional socialization that focus on the effects of other adults from outside the neighborhood on children's development and behavior (Jenks and Mayer, 1990 p115). Teachers, principals, public officials etc., enter the isolated neighborhood through institutions, affecting children's lives. Bauder (2001) argues that neighborhood effects operate by means of the way in which institutional practices judge the capabilities of youth; "institutional practices differ between neighborhoods and that local institutions use labels of 'dysfunctionality', based on an interpretation of the cultural attributes of their clients and service area to assess career potential" (Bauder, 2001 p. 594). Thus, poor children in a segregated area will be considered 'dysfunctional' for college education and will be socialized as such whereas

[12] Social Capital is a form of organization that arises when people form a structure of relations that facilitate action "making possible the achievement of certain ends that in its absence would not be possible" (Coleman, 1990 p. 300)

[13] Collective efficacy is defined as "cohesion among residents combined with the shared expectations for the social control of public space and their willingness to intervene on behalf of the common good (Sampson and Raudenbush 1999, Sampson et. al 1997) Collective efficacy is a task- specific construct that relates to the shared expectations and mutual engagement by adults in the active support and social control of children (Sampson et al 1997)

poor children in integrated neighborhoods will be pushed to keep up with the expectations. Thus, given that institutions are an important part of the neighborhood, they become part of an explanation of neighborhood effects.

The second group of models asserts that residential segregation might have positive effects on educational outcomes. The main approach sustaining that neighborhood homogeneity or segregation benefits educational outcomes is the relative deprivation hypothesis. Relative deprivation models assume that people judge their success or failure by comparing themselves with others around them. Heterogeneity or integration lifts the "veil of ignorance"(Rawls, 1971, chapter 1) under which "…no one knows his place in society, his class position or social status; nor does he know his fortune in the distribution of natural assets and abilities, his intelligence and strength, and the like" (Rawls, 1971 p.35). In other words, the conditions for just social life can be sketched if people are imagined in an "original position" in this original position people decide upon social rules from behind a "veil of ignorance" nobody knows anything about their own situation in the society. Children judge their academic success by comparing their school performance with that of their peers. Therefore, they will have a better concept of their own academic abilities if they are surrounded by similar children.

This investigation places inside the first set of hypotheses. Though our model is imperfect to detect which hypothesis is the correct one, i.e. what mechanism is actually mediating the effects of the concentration of the poverty in the educational results- my hypothesis is that residential segregation negatively affects educational outcomes and that this effect is independent from the individual situation of the children.

IV. Data and Methods

This analysis puts individual, school, and neighborhood data together in space. Individual data is available form the National System of Quality of Education Measurement (SIMCE) 2002, which applies every second year a standardized test to all children attending 4th and 8th grades of primary education. In particular I will be using math test scores. In addition, the SIMCE provides a survey of household socioeconomic status and other characteristics related to the socialization practices at home and at school. Although individual data cannot be spatially referenced, it can be nested within schools that can be geo-referenced and related to neighborhood data, available from the Chilean census 2002.

A. Multilevel Models

In order to test for the neighborhood effects, I implement two 2-level hierarchical models based on previous results from Mizala, Romaguera and Ostoic (2004).[14] These authors develop an education production function in two levels -individuals within schools- with the intention of modeling the individual and school heterogeneity in the educational results. In this study I adopt a similar strategy with the novelty of introducing the fixed effects of the level of residential segregation to pinpoint the effect of the latter on the test results and on the sensitivity to certain covariates.

The education production function at level one –within individuals- estimates the results of the SIMCE test (math) among 4th grade children in the metro area of Santiago, 2002. It is specified as:

$$MATH_{ij} = b_{0j} + b_{1j}ParSupp_{ij} + b_2 HoursStudy_{ij} + b_3 Male + b_4 Rpt_{ij} + b_{5j}SES_{ij} + m_{ij} \qquad (1)$$

At the individual level, it is assumed that the educational results are a function of the following explanatory variables of the child "i" attending the school "j": parental support, weekly homework/study hours, sex, if the child has not been promoted from one grade to the next one, and household socioeconomic status. Some coefficients vary throughout schools. In other words, individual test scores and their sensitivity to some of the covariates - socioeconomic status, and to parental support- vary around the school average according to the particular characteristics of the school. Inversely, I assume that the differential between boys and girls and the effect of repeating a grade are constant for all children in all schools.

At the school level, the model assumes that the variables explaining test results are the type of school, socioeconomic status of the school and the geographic situation of the school. The hypothesis is that -after controlling for the household SES- private non subsidized schools (PP) have higher test results than private subsidized (PS) that at the time have higher scores than public schools (P). At the same time, I test the hypothesis that there is a composition effect in the SES of the household and the individual. In fact, Mizala, Romaguera and Ostoic (2004) find that the effect of school SES on test results is greater than the effect of household SES. This

[14] Mizala et al's paper is based on Rodríguez (1998), Aedo and Larrañaga (1994), Aedo (1997), McEwan and Carnoy (2000), McEwan (2001), Mizala and Romaguera (2000, 2001), Bravo, Contreras y Sanhueza (1999), Tokman (2002), Sapelli and Vial (2001), Gallego (2002), Hsieh and Urquiola (2002).

composition effect has been demonstrated to be greater for public schools where household socioeconomic status is remarkably smaller (Mizala et al, 2004).

However, the main goal of this article is to test the hypothesis that the educational results vary around the average of the school depending on whether the school locates in a segregated, mixed or in an affluent neighborhood. The hypothesis is that the geographic location of the school is important for individual test scores inasmuch as space catalyzes socializing processes that are affected by the geography of opportunities and the concentration of poverty and/or wealth in the neighborhood. This way, a school located in a segregated area would show processes of collective and institutional socialization that are unfavorable for educational results, regardless the type and the socioeconomic status of the school and the characteristics of the children. In order to test the hypothesis of the "neighborhood effects" a dummy of concentration of poverty (SEG) and a dummy of concentration of wealth (AFL) are included in level 2 as follows.

LEVEL 2: INTERCEPT

$$b_{0j} = g_{00} + g_{01}PS_j + g_{02}PP_j + g_{03}SES_jP_j + g_{04}SES_jPS_j + g_{05}SES_jPP_j + g_{06}SEG_j + g_{07}AFL + e_{00} \quad (2)$$

LEVEL 2: PARENTAL SUPPORT

$$b_{1j} = g_{10} + g_{11}SEG_j + g_{12}AFL_j + e_{11} \quad (3)$$

LEVEL 2: HOUSEHOLD SES

$$b_{5j} = g_{50} + g_{51}P_j + g_{52}PP_j + e_{55} \quad (4)$$

In order to identify hose areas where poverty concentrate I use the dimension of clustering (Massey and Denton, 1988) in order to evaluate the effects of the "embeddedness of poverty" on educational attainment. I compute this dimension of segregation using LISAs (Anselin 1995)[15]. Two problems arise when measuring segregation as the dimension of clustering: selecting the

[15] LISAs is the acronym for Local Indicator of Spatial Autocorrelation. The indicator I am using is the local Moran's I

$$I_i = (x_i - \bar{x})\sum_j w_{ij}(x_j - \bar{x})$$

where xi is the percentage of low status families in neighborhood "i", xj is the percentage of low status families in neighborhood "j" and wij is the corresponding value of the distance matrix that takes value 1 for neighboring units – i.e. spatial units "i" and "j" are adjacent- and 0 otherwise. The local Moran can be statistically tested to identify the areas that where clustering is statistically significant. These areas are called the hot spots. One of the main advantages of the LISAs is that they can also identify cold spots and islands–i.e. areas with high proportion of observation surrounded by areas with low proportion of observations or vise versa

area that will be used as the neighborhood and constructing a meaningful contiguity or neighborhood matrix. Both issues imply making assumptions about the sphere of influence that is relevant for the problem under analysis. Large scale segregation –measured using a relatively large area- assumes that the processes of socialization affecting children's achievement occur in a relatively large area. Children would be affected by people that are relatively far away. On the other hand, small scale segregation assumes that children's sphere of influence is geographically concentrated in a relatively small piece of land. I select two different spatial units to be used as the neighborhood in order to test for the hypothesis of the neighborhood effects at small and large scale respectively: the census zone[16] and the census district[17]. In both cases I measure the "embeddedness" of poverty –and affluence- using a queen contiguity matrix of 1 adjacent unit only (Anselin, 1995).

B. Spatial Models

Spatial models are implemented to test the hypothesis that educational outcomes are spatially dependent. This is to say that school outcomes are correlated to what happens in nearby schools. Thus, if a particular school shows low test scores, it is likely that all schools in the vicinity will also show low scores. This makes sense given the uneven geography of opportunities and the high level of residential segregation. The question though, is about the significance of the contagious process between one school and the schools nearby. In order to answer the question I run a simple OLS model (equation 1) and test for spatial autocorrelation.

$$MATH_{ij} = (Type_i, SES_i, SEG_j) \qquad (5)$$

V. Results: Neighborhood Effects

The unconditional model shows that individual test revolve around a grand mean of 249 points that significantly varies from one student to another and also across schools. Almost 70% of the model's total variability is potentially explained by individual and household characteristics whereas the remaining 30% is significantly explained by contextual characteristics of the school and the neighborhood in which it locates. [18]

Table 3 shows the results of models -1, 2, 3 and 4. The first two models measure segregation of the area in which the school is located using relatively small space units -census zones- whereas

[16] The city of Santiago is divided into 880 census zones with an average of 3,890 people.
[17] Santiago is divided into 335 districts with an average of 13,866 people each.
[18] Table below shows random effects for the unconditional model.

Random Effect		Standard Deviation	Variance Component	df	Chi-square	P-value
level-2,	U0	29.84906	890.96661	920	23324.01309	0.000
level-1,	R	45.15439	2038.91849			

models 3 and 4 measure segregation using wider areas or census districts. Models 1 and 3 include only the type of school whereas models 2 and 4 include the socioeconomic status of the school in order to test for the composition effects hypothesis.

TABLE 3: HIERARCHICAL CONDITIONAL MODEL: MATH TEST SCORES, 4TH GRADE 2002. FIXED EFFECTS

Variables	Model 1		Model 2		Model 3		Model 4	
Intercept								
Intercept	247.26		208.83	**	246.63		207.21	
	(1.493)	***	(4.831)	*	(1.778)	***	(5.186)	***
Private Subsidized	8.54		12.91		8.578		11.25	
	(1.936)	***	(8.469)		(1.984)	***	(8.745)	
Private Non Subsidized	17.927		20.359		16.382		7.69	
	(3.731)	***	(35.839)		(3.793)	***	(36.31)	
SES_EST* P			14.474	**			14.312	
			(1.713)	*			(1.785)	***
SES_EST * PS			10.676	**			11.22	
			(2.136)	*			(2.126)	***
SES_EST * PNS			16.616				13.72	
			(7.235)	**			(7.31)	*
Concentration of Poverty	-13.007		-7.198		-5.49		-0.52	
	(3.215)	***	(3.08)	**	(2.298)	**	(2.21)	
Concentration of Affluence	3.201		3.118		5.3		1.731	
	(2.095)		(1.97)		(2.042)	**	(1.93)	
Parental Support								
Intercept	7.41		7.126	**	6.818		6.496	
	(0.419)	***	(0.412)	*	(0.576)	***	(0.576)	***
Concentration of Poverty	-3.381		-3.008		-0.646		-0.28	
	(0.947)	***	(0.94)	**	(0.733)		(0.732)	
Concentration of Affluence	0.19		0.49		1.539		1.532	
	(0.826)		(0.808)		(0.831)	*	(0.82)	*
Household SES								
Intercept	8.716		7.658	**	8.732		7.69	
	(0.793)	***	(0.807)	*	(0.79)	***	(0.801)	***
Public	-0.84		-0.984		-1.04		-1.04	
	(1.135)		(1.163)		(1.132)		(1.163)	
Private Non Subsidized	3. 794		4.65		3.43		4.236	
	(1.685)	***	(1.675)	**	(1.65)	**	(1.64)	**
Sex (1= boy)	6.44		6.579	**	6.41		6.546	
	(0.761)	***	(0.755)	*	(0.761)	***	(0.757)	***
Repeat a Class	-7.216		-6.77	**	-7.3		-6.76	
	(1.246)	***	(1.255)	*	(1.25)	***	(1.256)	***
Homework/ study hours	0.0252		0.01		0.053		0.03	
	(0.941)		(0.335)		(0.336)		(0.335)	

Note: *** p-val < 0.001; ** p-val < 0.05; * p-val <0.1. Error Standard in parenthesis.

All the models demonstrate that in general, male children have around 6.5 test points more than female children, whereas repeating a grade diminishes test results in around 7 points. Homework and home-study hours do not significantly affect math achievement whereas, in all models, the parental support turns out to be essential for the test results; as we will see next, this effect is not equal in segregated zones that in mixed or affluent zones.

Household socioeconomic status significantly reinforces educational results. Contrary to Mizala et al (2004) results I find that the effectiveness of the household SES is significantly higher among children attending private non subsidized schools whereas the effect is not significantly different between children in public schools and children in private subsidized schools. [19] This way, an additional household SES unit contributes between 7 and 8 additional test among children of private subsidized and public schools whereas it contributes around 12 points to children attending private non subsidized schools. Models 2 and 4 control by the effects of school SES by means of introducing school SES times the dummy variable associated to each type of school.[20] Models 2 and 4 show that -when controlling for school SES- attending one or another type of school is not relevant as long as the schools have the same SES (average). In other words, the dummy variables associated to the type of school are not significantly different from zero. In this sense, our results do not allow concluding that, in the metropolitan region of Santiago, private subsidized schools are better than public schools. On the contrary, the difference in test results is explained by socioeconomic advantages of the school. [21] It is possible to conclude that the effect of the school SES is different in the different types of schools. Moreover, once I control for socioeconomic situation of the neighborhood in which the school is located, we can conclude that school SES is more effective among private non subsidized schools and public schools than in private subsidized schools. This implies that there is an important composition effect of SES by which SES is more important in subsidized schools – either public or private- rather than in non subsidized schools.

A. Small scale segregation: schools located in segregated zones.

The first two models give count of the effect of residential segregation on the educational results when segregation is measured at small scale. That is to say, in models 1 and 2 the "neighborhood" is approximated to the census zone in which is the school is located. In this case, when a school belongs to a segregated zone, it means that it is geographically located in a census zone with low socioeconomic status and that the zone is significantly surrounded by other zones of low socioeconomic status.

Map 2 shows the distribution of segregated census zones in city of Santiago. These zones are demarcated in red color and are located in the southern periphery and the nor-west of the city, in the municipalities of La Pintana, Renca, Cerro Navia Hill, Pudahuel, Huechuraba and Conchali. In addition, other zones of similar characteristics are dispersed in the municipality of Penalolen, Cerrillos and San Miguel. In blue, are the affluent zones which, contrarily to segregated areas are

[19] It is necessary emphasizing that the authors work with the complete sample of about 5,000 schools in the year 1999. In this model, I include schools belonging to the metropolitan region only, excluding rural zones.

[20] Since school SES is centered on the general average the unweighted variables of type of school reflect the sensibility of the individual test results to the type of school when the school has an average SES.

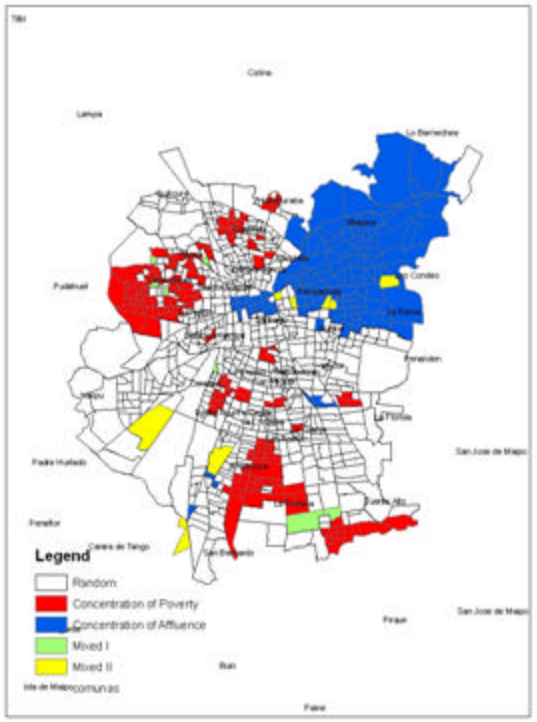
[21] When controlling for both school and household SES Mizala et al find that the type of school is still a good predictor of test results; this suggests that private schools are actually better than public schools and that the test differences are not only explained by SES. Our result surprises, since there is a consensus about the academic superiority of the schools that function under a logic of competition. It is worth noting that the results of this paper are valid for the metropolitan urban region only. Extending the sample can lead to different results (Mizala and Romaguera, 2000a, 2000b). Nevertheless, since my goal is to evaluate the effects of the segregation in urban zones forces us to restrict the sample.

zones of high SES that are significantly surrounded by other zones of high SES. In others words, blue areas represent the zones where affluence concentrates. These areas are located mainly in the northeastern part of the city of Santiago. Zones demarcated in green and yellow represent what we have called wealth islands and poverty islands respectively. These are zones of high SES surrounded by zones of low SES vice versa. In white are the random areas. In these areas the SES in the surroundings cannot be predicted by the SES in the area.

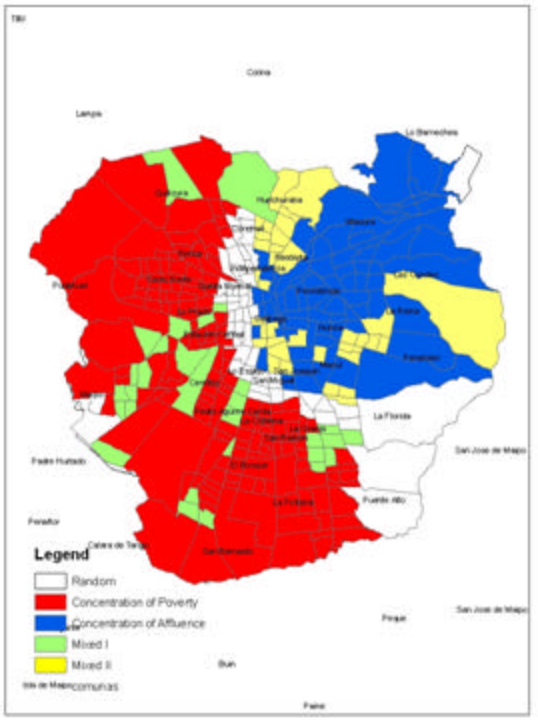
The results of the first 2-level model show that -controlling for the household SES and the type of school- children attending a school located in a segregated area have on average a score that is around 13 points lower than the score of those children attend schools in mixed or random neighborhoods. Interestingly, attending a school in an affluent area plays no role in the test results. Once controlling by school SES, the negative effect of residential segregation diminishes from 13 to around 7 points. However, it remains statistically significant. In other words, some of the gap in test results is explained by household poverty while other portion is explained by school poverty. Still, the concentration of poverty at the neighborhood level explains an important part of the test results. Thus, when excluding the spatial effect of segregation we would be imputing more explanatory power than deserved to both type of school and individual and school SES.

The effect of parental support on educational results significantly varies with the spatial situation of the census zone in which the school is located. In zones mixed and affluent, parental support yields around 7 additional points of SIMCE. Segregation diminishes the effectiveness of parental support to 4 points. On the contrary, affluence does not have a significant effect on test scores. It does not affect the effectiveness of the parental support either.

MAP 2: SANTIAGO: SEGREGATED, AFFLUENT AND MIXED CENSUS ZONES.



MAP 3: SANTIAGO: SEGREGATED, AFFLUENT AND MIXED CENSUS DISTRICTS



B. Large scale segregation: schools located in segregated districts.

Models 3 and 4 differ from models 1 and 2 in as much as the former account for the sensitivity of test results to the residential segregation measured at large scale whereas the latter measures segregation using a smaller spatial unit. Thus, instead of approximating the neighborhood to the census zone I use census districts. Map 3 shows distribution of the segregated, affluent and mixed zones in the districts of the city of Santiago. Since Local Moran's I calculates clusters based on local averages, the location of the different areas is similar, but the zones significantly segregated (in red) and significantly affluent (in blue) are of greater size and cover a more important portion of the city.

When segregation is measured at greater scale, segregation maintains a significant negative effect on test scores although the effect becomes smaller (-5.5 points). However, when controlling by school SES and household SES, the effect of concentrated poverty at the district level disappears. This means, that large scale segregation on greater scale is indeed less negative than small scale segregation: the effect tends to disappear as the spatial unit grows. Although this seems counterintuitive, it is actually not. A school is located in a segregated district when the district is "relatively" poor and surrounded by districts also relatively poor. Since the district is greater in size and population than the zone, a segregated district is calculated on a wider range of poverty values. Thus, the cluster can hide a much more heterogeneous reality – a higher standard deviation- than the zone. In the end, when measured at different scales segregation reflects different phenomena.

Similarly, the unfavorable effect of the segregation on the sensitivity of test results to parental support disappears when the segregation is measured on a greater scale. Interestingly, when the establishment is located in an affluent district –rather than in an affluent zone- this spatial affluence raises the effectiveness of the parental support. Although this article is not aimed at studying the effects of the concentration of wealth on educational results, it is worth noting that, while the effects of segregation appears on a smaller scale, the effects of the affluence have tend to appear as scale increases. This is a further corroboration that greater heterogeneity is beneficial, in as much as it diminishes the adverse effects of the concentration of the poverty and increases the positive effects of concentration of wealth.

VI. Results: Spatial Spillovers

At the aggregate level, schools' math test scores are a function of the type of school (either public, private subsidized or private not subsidized) and the socioeconomic status of the school and of the area in which it is located. Table 4 shows the results of the OLS regression according to which private non subsidized schools have 17.5 additional points than public schools whereas private subsidized schools have 59.3 points more than the latter. Higher SES in the school implies higher test scores. However, the sensitivity of test scores to school SES is not the same in all types of schools. While one standard deviation above the average represent 12.6 additional points in public schools and 13.7 additional points in private non subsidized schools, it is relatively more important in private subsidized schools where being

above the average represents 16.4 additional points.[22] Finally, the results tell us that schools in segregated areas show 4 points less than those schools located in affluent and mixed areas.

TABLE 4: OLS RESULTS

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	233.0828	1.079796	215.8581	0.0000000
PS	17.57418	1.370708	12.82124	0.0000000
PP	59.33009	2.031929	29.1989	0.0000000
S_SESP	12.56679	1.023128	12.28272	0.0000000
S_SESPS	16.39764	0.9630994	17.0259	0.0000000
S_SESPP	13.70246	1.732819	7.907613	0.0000000
SEG	-4.30205	1.929797	-2.229276	0.0260378

Dependent Variable is School's math test score. F-statistic: 252.775 Prob 0.000 Adjusted R-squared: 0.621245

The diagnostics for spatial autocorrelation allow concluding that there is evidence of spatial dependence in the form of a spatial lag rather than a spatial error. In fact both the Lagrange Multiplier (lag) and the Robust Lagrange Multiplier (lag) are statistically significant. [23] In other words, the educational outcomes in the schools nearby[24] and the variables explaining them explain in part the school's test scores. Given the evidence, I run the same model including the spatial lag as an explanatory variable. The results are shown in table 5. Once correcting for the problem of spatial autocorrelation, the model –estimated using maximum likelihood- gives more reliable coefficients. In general the coefficients do not change considerably: all of them remain statistically significant and –as expected- decrease a little bit. What is interesting though is that the spatial lag coefficient is positive and significant which means that one extra point in the schools nearby represent 1.12 additional points.

[22] School SES is centered around the group mean. Thus, when I mention the "average" I refer to the group's average (i.e. the mean on each type of school) and not to the grand mean.

[23] Diagnostics for Spatial Dependence:

TEST	MI/DF	VALUE	PROB
Moran's I (error)	0.007444	1.2869881	0.1980985
Lagrange Multiplier (lag)	1	5.7467846	0.0165189
Robust LM (lag)	1	4.7646332	0.0290503
Lagrange Multiplier (error)	1	0.9887198	0.3200555
Robust LM (error)	1	0.0065684	0.9354054
Lagrange Multiplier (SARMA)	2	5.7533530	0.0563216

[24] Schools nearby are those contained in the area defined as the "school's vicinity". In this study I use a maximum distance of around 2 miles (3,000 mts).

TABLE 5: SPATIAL LAG RESULTS

Variable	Coefficient	Std.Error	z-value	Probability
Spatial Lag	1.122026	0.525768	2.320909	0.0202917
CONSTANT	203.2004	12.91829	15.72967	0.0000000
PS	17.45747	1.362889	12.80917	0.0000000
PP	55.71468	2.543621	21.90369	0.0000000
S_SESP	11.90105	1.06015	11.22582	0.0000000
S_SESPS	15.86976	0.9806531	16.18284	0.0000000
S_SESPP	12.92138	1.754783	7.363521	0.0000000
POB_SEG1_1	-3.827333	1.927649	-1.985492	0.0470896

Dependent Variable is School's math test score. Likelihood Ratio Test = 5.288564 , p-val: 0.0214659

VII. Conclusions

The analysis of the neighborhood effects on educational outcomes demonstrate that concentration of poverty in the residential vicinity is disadvantageous to children's educational outcomes, beyond and above household poverty, the type and resources of the school and the individual characteristics. Educational outcomes of children attending schools in segregated areas tend to be worse than those of children attending schools in mixed neighborhoods. This evidence support the hypothesis that there is a process of collective and institutional socialization taking place in the residential and school neighborhoods (Jenks and Mayer, 1990; Sampson et al 1999; Coleman, 1990; Bauder, 2001). Collective and institutional socialization will be affected by the level of spatial segregation. Thus, the data shows that parental support tends to be less effective in segregated neighborhoods than in mixed and affluent neighborhoods.

Our findings contradict the hypothesis that neighborhood homogeneity might promote educational outcomes or the relative deprivation hypothesis. Relative deprivation models assume that people judge their success or failure by comparing themselves with others around them. In such models, heterogeneity, integration, lift the "veil of ignorance"(Rawls, 1971). Under this veil people situate in an "original position" in which they decide upon social rules knowing nothing about their own situation in the society; in doing so, conditions for just social life deploys. Likewise, children judge their academic success by comparing their school performance with that of their peers. Therefore, they will have a better concept of their own academic abilities if they are surrounded by similar children.

In addition, the results change with the scale of analysis. The effect of segregation on educational outcomes tend to be more negative when considering a relatively large area as the "residential vicinity" than when the neighborhood is measured as the census block level. This evidence suggests that the problem of residential segregation differs when measured at different scales. Large scale segregation tends to be less harmful than small scale segregation.

The case of the city of Santiago is particularly interesting since, it shows high levels of socioeconomic residential segregation paired with high levels of school segregation. Geography of opportunities is uneven which deters life chances later in life. However, during the last decade, the scale of segregation has actually decreased due –in part- to the development of gated communities in traditionally poor areas. Gated communities have shortened of physical distances between the "schools for the rich" and the "schools for the

poor" which may well generate education spillovers that affect educational outcomes and subsequent life chances for poor children, even if the problem of school segregation remains unchanged.

When the scale of segregation decreases, new types of interaction emerge between socioeconomic groups that have been historically separated. High income population -now residing in the traditionally poor neighborhoods- is likely to attract investment in public and private infrastructure. In particular, the increasing demand for schooling for wealthy children attracts schools -meant to serve wealthy children- into the traditionally poor neighborhoods. The narrowing of the spatial distance between the schools for the poor and the schools for the rich might follow the same rationale as for individuals. Institutional practices might spread out from one school to another given that schools are located closer in space which uplifts the quality of education and affects institutional socialization of poor children. Ultimately, institutional interaction modifies the neighborhood context and positively affects educational outcomes of poor children.

Although spatial models allows concluding that there is .a significant process of contagion from one school to another in its vicinity, I can only hope that this contagion goes from high scores to low scores –thus increasing educational outcomes- and not the other way around.

I would like to finish by asserting that although quantitative methods are fun and enlightening (sometimes), they fail to tell us what kind of mechanisms are actually mediating both the neighborhood effects and the spatial spillovers. Is it collective socialization? Is it institutional socialization? Are peers important at such young age? Do these mechanisms operate in isolation or do they reinforce one another? In other words, I am convinced that this analysis needs to be enriched by the insights obtained in the field. The next step in my research is to contrast these results with the findings from the interviews to mothers, teachers and principals from several schools located in segregated and non segregated areas in the city of Santiago. I hope qualitative and quantitative methods in tandem will be much more enlightening than either of them on its own.

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