Intergenerational Mobility After Expanding Educational Opportunities: A Quasi Experiment

By Francisco Meneses*

Intergenerational mobility has been linked to both the quality of neighborhoods and the quality of schools and schooling. Understanding the incremental value of investments in either domain is difficult because in many settings, including the U.S., school choices are coupled with neighborhood geography. I take advantage of student access to new subway lines built in Santiago, Chile, to measure the impact of education independent from neighborhood quality using a quasi-experimental design. In Santiago with an established open enrolments school system, the new subway lines substantially reduced transportation costs and increased access to educational opportunities among lower income students. With student level test score data linked with data on parent's education and demographics, I use a Difference-In-Difference (DID) approach to shows that treated students increased their intergenerational income mobility, with students' future income ranking increasing on average by 2 percental points above that of their parents, or a 5% of wage increase. Moreover, the paper finds that this is driven by changes in the field of higher education study, not improved test scores or graduation from higher education.
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I. Introduction

How important are educational interventions compared to neighborhood environments for social and economic mobility? Intergenerational mobility could be affected by factors beyond the neighborhood of residence such as educational opportunities. In the US students are often required to attend neighborhood schools, therefore in that case is not easy to disentangle the effect of education from that of neighborhoods on intergenerational mobility. As such, much of the recent research fails to dis-aggregate more general effects of neighborhood environments from the effects of educational opportunities (Ananat et al., 2011; Chetty et al., 2014a; Chetty and Hendren, 2018). Nonetheless, there is no doubt that educa-

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tion is an important factor impacting intergenerational mobility, as more years of education has shown to cause increased intergenerational mobility (Maurin and McNally, 2008; Oreopoulos et al., 2006; Pekkarinen et al., 2009), and it is certainly arguable that students who attend better schools have additional positive social-mobility outcomes. Therefore, it is important to determine if students can increase their intergenerational mobility by attending "better" schools which may be located beyond their neighborhood of residence. The effect of school quality versus neighborhoods on intergenerational mobility is important since it generates different policy solutions to promote social mobility. While some authors propose the creation of housing subsidies or vouchers, educational experts have promoted open enrolment systems. If the objective is to generate intergenerational mobility, instead of moving the family to a different neighborhood, an option that can be extremely disruptive and expensive, students could be simply allowed to attend a school in a different neighborhood. The educational literature in the US and Chile has found that there is an endogenous problem with school selection, as parents tend to choose schools considering quality, distance, and other characteristics such as religious orientation and discipline practices (Chumacero et al., 2011; Valenzuela et al., 2014; Blagg et al., 2018). A quasi-experiment could help determine the relative importance of neighborhood environment versus education on intergenerational mobility. Chile has an open enrolment system financed under a voucher scheme, where parents can choose schools from any neighborhood and no publicly financed school is allowed to choose their students by location. This allows students to attend schools far from home (Canals et al., 2015). A new subway line in the capital city of Santiago generated an external shock in 2005, allowing for increased educational opportunities for students by reducing their transport time to schools outside of their neighborhoods, promoting school switches to school beyond their neighborhood (Asahi, 2014; Herskovic, 2020). The new subway line is used as a quasi-experiment to evaluate the impact of reduced transport cost and the subsequent increase in educational opportunities. A difference-in-difference (DID) measures the Intent to Treat Effect (ITT) of the subway on students' intergenerational income mobility. Students in the areas affected by the subway are compared to control students who were later affected by another subway expansion. This allows us to detangle the advantages a new subway has on the neighborhood — such as easier access to jobs — from those specifically related to secondary education. A novel dataset of educational trajectories, family data, and wages is used to estimate intergenerational income mobility using a rank-rank specification (see Chetty et al. (2014b)) as the outcome variable. This dataset was created by merging educational datasets from the Ministry of Education and Labor, analyzing one national cohort of 8th graders in 2004. These 250,000 thousand students are followed for over fourteen years with detailed data on educational, residential, and labor market trajectories. The DID estimations find that affected individuals who were in middle schools that finished in eighth grade — forcing them to choose a high school— could take advantage of

the new subway line, have a higher intergenerational income mobility of 2 percentage points above their parents' income ranking, or a 5% increase in wages. The exploration of several channels of impact suggests that graduation from tertiary education and choosing different areas of study could explain the increased income mobility, even when these students reduce their scores in standardized tests. This paper contributes to the intergenerational mobility literature the developing world and adds to the school choice and open enrolment discussion as it finds a positive effect for allowing low-income students to choose schools beyond their neighborhood, and provides evidence for a school system based entirely on open enrolment. This paper is organized as follows, Section 2 reviews the theoretical and empirical literature on social mobility. Section 3 reviews the school system in Chile, Section 4 describes the empirical strategy and the data sets. Section 5 shows the results and Section 6 presents a brief discussion of the findings.

II. Neighborhoods, Education and Social Mobility

While the work on social mobility analyzes intergenerational effects, particularly the effect of neighborhoods, the educational literature describes the factors that influence parents to choose among different educational paths and institutions. The motivations of parents' school choice selections are important, as they reflect — in part — parental concern for the long-term outcomes for their children. This section briefly reviews the theoretical and empirical research on social mobility and school choice relevant for this research. The dilemma of neighborhood environments versus education is important as it suggests different public policies to promote social mobility. While some authors propose the creation of housing subsidies or vouchers, others policy experts propose open enrolment (or school vouchers); instead of moving the family to a different neighborhood, it may be an option to have students attend schools in those neighborhoods instead. The school choice solution would allow the families to maintain their social networks within their communities while allowing the student to have better educational opportunities. Moreover, the school voucher solution is less expensive than the housing voucher subsidy. This situation thus demands further research in this arena before large scale policy programs are implemented. Low social mobility is important as it affects the capacity of individuals to live up to their full potential. Moreover, low social mobility is inefficient as it reduces the capacity of the economy to obtain maximum productivity from individuals. The idea of the "American dream" — rooted in the idea that a citizen can prosper regardless of the economic conditions in which they are born — is a reason why some citizens may accept inequalities in democratic countries (Corak, 2013). However, recent estimates of social mobility in the developed world have shown that it is lower than previously estimated (Chetty and Hendren, 2018; Corak, 2013; Landersø and Heckman, 2017). In their seminal work, Becker and Tomes developed a theory of intergenerational mobility that has served as the base for the analysis of social mobility and the cornerstone of further theoretical and empirical im-

provements in the literature Solon (2004). In their model, parents influence the outcomes of their children through several channels: genetics and human capital investment as well as social reputation and connections (Becker and Tomes, 1979). Parents invest in their children and then these investments interact with the market and generate revenues. The recent availability of large administrative datasets from tax records and surveys has benefited this empirical literature, allowing for detailed estimations of Intergenerational Elasticity (IGE) (Palomino et al., 2018). In example, for the United States, initial estimations of social mobility were close to 0.2 (Becker and Tomes, 1979), while more recent estimates using detail data are between 0.3 and 0.5 (Chetty et al., 2014a; Connolly et al., 2017; Mazumder, 2005). Moreover, the empirical literature has shown that social mobility is affected by aspects such as ethnicity, early childhood education, neighborhood, family characteristics, college education, and social class (Chetty and Hendren, 2018; Heckman, 2006; Streib, 2011; Torche, 2011, 2015; Zimmerman, 2019). There is a long history in the literature regarding the analysis of the effect of education on wages and social mobility. One of the problems in this analysis is that education is endogenous to family characteristics as parents affect their offspring's educational attainment (Björklund and Jäntti, 2009). Parents choose the schools of their children or the neighborhood where to live according to their income level, education and other factors. Several approaches have been used to assess the causal effects of education on social mobility. In particular, policy expansions of education and quasi-experiments have been useful tools to distangle and identify the effect of family background and education (Black et al., 2005; Carneiro et al., 2007; Chevalier, 2004; Machin, 2007; Magnuson, 2007; Maurin and McNally, 2008; Oreopoulos et al., 2006; Pekkarinen et al., 2009). Most of this research has posited the importance of education, supporting the role of educational public policies to promote social mobility (Björklund and Jäntti, 2009). Previous literature has shown the relatively high importance of the family over other background factors like neighborhood of residence (Björklund and Jäntti, 2009). However, recent research has revitalized the idea that neighborhoods are important in promoting social mobility (Ananat et al., 2011; Chetty et al., 2014a). New evidence, using randomized residential voucher programs in the US, have shown the importance of neighborhoods on wages and social mobility (Bergman et al., 2019; Chetty et al., 2016). However, this new research done in the US is linked not only to geographical environments but also to educational opportunities, bundling several factors into their "neighborhood" impact. In the US geographically-set school districts determine the schools that students can attend. Therefore, this literature combines two factors: the social environment in neighborhoods with the educational opportunities and quality. Consequently, there is a limit to how much it's possible to learn from empirical experiences in the US . Luckily for the literature, other countries have educational systems that do not bound educational opportunities to the neighbourhood of residence. Therefore, there is an opportunity for international evidence to contribute to the

current literature and to test the importance of the neighbourhood versus education on social mobility. However, there are challenges to measure the impact of education on intergenerational mobility as school choice is endogenous to family characteristics, and thus direct estimations of educational quality on mobility will be biased (Hoxby, 2000). To solve the endogeneity issue, the economics of education literature has relied successfully on lotteries, randomization and external shocks to evaluate the impact of educational interventions Abdulkadiroglu (2013); Hoxby (2000). Therefore, a quasi-experiment in an educational system with school choice can help to analyse the impact of the expansion of educational opportunities on intergenerational mobility.

III. Schooling in Chile

There are multiple mechanisms worldwide by which students are assigned to schools, ranging from models that regulate school zones to systems of complete free choice or open enrollment systems. In the OECD there are countries, like the US where 69 % of Students enrollment is define by their residence, while other countries, such as Chile, were less than 10% of schools use residence as a restriction (OECD 2017). School systems that allow parental choice, rely on the assumption that maximizing the rational and informed choices of the families could promote optimal competition in the educational market (Friedman, 1955) and increase social welfare. The promoters of these systems argue that they increase efficiency, competition, quality, and opportunities for students (Sapelli and Vial, 2002; Brighouse, 2000; Hoxby, 2000; Cohen-Zada, 2009). The detractors argue that school choice systems increase inequality and segregation (Valenzuela et al., 2014; Elacqua, 2012; Ladd and Fiske, 2003; McEwan and Carnoy, 2000). Additionally market failures could prevent school choice systems from achieving optimum competition conditions (Mizala and Romaguera, 2000; Carnoy, 1998). Thus, there is no consensus regarding the effect of school choice systems on educational outcomes, especially given that most results are contradictory, small, or insignificant (Mizala and Romaguera, 2000; Bustos et al., 2007). There are few countries in the world with as extensive of a school choice system as Chile (OECD, 2017; McEwan et al., 2008) which includes over 90% of students. Furthermore, the school system in Chile has two characteristics that are useful for this study: high stratification and segregation in the school choice environment. In Organization for Economic Cooperation and Development (OECD) countries, a high proportion of educational education is explained by the families' socioeconomic status (OECD, 2018). This stratification tends to lead to higher quality schools being located in higher income neighbourhoods, therefore resulting in limited educational opportunities for low-income students (Elacqua, 2012). The school choice literature in Chile has shown that it is also affected by this stratification, finding that parents tend to choose schools considering distance as well as quality, safety, and other characteristics like religious orientation and discipline (Chumacero et al., 2011; Urzua et al., 2010; Valenzuela et al., 2014). The edu-

cational system in Chile does not put any geographical limits on school choice, parents can choose schools far from home. However lower income parents tend to live in lower income neighborhoods and preferences for distance can limit them to local lower-quality schools. Thus, policies that reduce transportation costs could promote school switches, allowing low income students to attend higher "quality" schools.

In this educational system it is possible to decouple the neighborhood from the school effect on social mobility. In the Chilean educational sector, schools benefit from accepting students, as students bring vouchers or governmental subsidies; Chile has a mixture of public, privately owned and publicly funded (private voucher) and private paid schools. In the country, 93% of schools are financed under a voucher program with only 7% of schools being completely private. Public schools in Chile are organized according to educational cycles: separating students from kindergarten to 8th grade (k-8) and from 9th to 12th grade (9-12). Comparatively, private voucher schools tend to have to run from kindergarten to 12th grade (k-12). In the system it's possible to see a re-shuffling of students after eighth grade, as there is an important proportion of students moving to different schools (Canals et al., 2015). In this school environment, this paper uses a new subway line as a quasi-experiment. This subway line promoted a safe, inexpensive, and fast way for students to attend schools in different neighborhoods. Other authors have used this subway shock (Agostini and Palmucci, 2008), to investigate several effects, including to investigate the change in schooling opportunities (Asahi, 2014; Herskovic, 2020).

IV. Empirical Setting

A. A New Subway Line

This subsection reviews a quasi-experiment, the inauguration of the new subway in Santiago and the impact from how it made it easier for students to switch to schools outside of their neighborhoods. The scenario of a spatially segregated city, with stratified educational opportunities (Elacqua, 2012) was affected by key event. During the mid-2000s an important expansion in the subway system was inaugurated, in the context of great inequality in Santiago and a lack of transport services for the lower income groups (Asahi, 2014; Herskovic, 2020). This expansion in the subway system increased the proximity of millions of households to the subway network, affecting mainly low and middle income groups (Asahi, 2014). The inauguration in 2005 of subway lines 4 and 4A, in Santiago (See Figure 1) connected some of the most populated municipalities in the city to the subway network, increasing their educational opportunities (Appendix I). The Santiago subway has some notable characteristics, specifically it is clean, fast, safe, and inexpensive for students. The impact of the subway networks has been analyzed by several authors. In terms of real estate, it has been documented that housing prices increased at a distance of 1000 meters from subway stations (Agostini and

Palmucci, 2008). Similarly, the effect of school switches from the new subway line has also been found to have an impact to as far as 2000 meters from the subway stations (Asahi, 2014; Herskovic, 2020). In this particular case, as students graduated from this middle school, they could take advantage of the new subway line to attend schools in different parts of the city (Appendix II). The surveys of origin-destination trajectories of the Santiago Subway Metro S.A, have discovered that that 80% of travelers walk 300 meters or less to and from the subway stations and that 98% of travelers walk 600 meters or less to and from the subway stations (Appendix II).

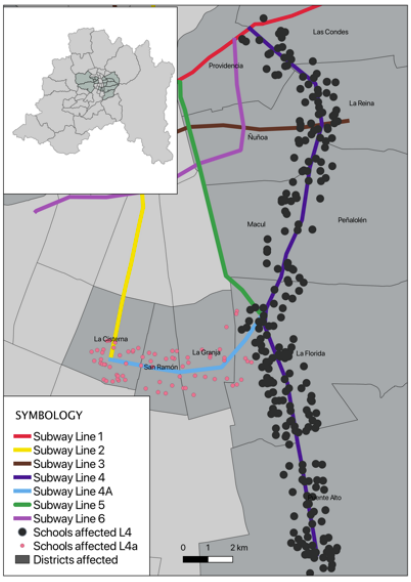
Beside lines 4 and 4a, another subway expansion occurred in Santiago in 2011. This later subway expansion occurred in a different part of Santiago, but also connected individuals with similar income levels to the subway network. Students affected by the 2011 subway expansion are the control group since the expansion happened after they had left high school. Therefore, the expansion did not promote school switches, but it did have an impact on many other relevant economic factors as labor markets, land value, college access, etc. This allows us to detangle secondary school affects from many other potentially confounding factors. To identify treated and control students or first best solution would be to use their home address, however, it's no possible to have it for all individuals in the sample. A second-best solution is to use their middle schools, as students tend to live close their middle school (Canals et al., 2015) (For a test of this assumption see Appendix III). I define treated students as students enrolled in 8th grade in the middle schools around the impacted areas by the new subway lines 4 and 4A. The control group are the students in 8th grade in middle schools around the impacted areas of the line 5 expansion. This method to define the treatment and control group assumes that if students were able to walk to their middle school, they would also be able to walk to the new subway stations and use the subway. The selected middle schools are shown in Figure 1.

B. Data Sets

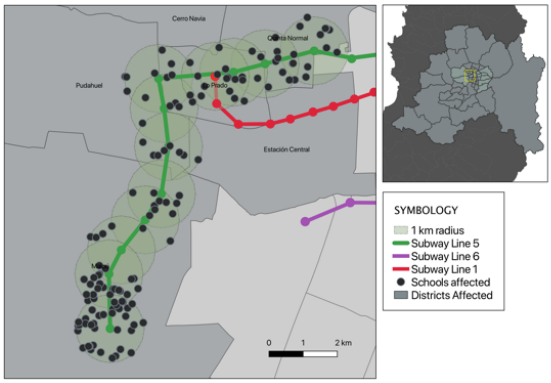
To analyze social mobility and wages, a panel data set is created following students from 13 to 27 years old. These data sets come from the Ministry of Education and the Ministry of Labor which were merged by the Ministry of Labor and all individual identifiers erased. The initial data set documents the results of a national mandatory test administered to students in the 8th grade and 10th grade– the SIMCE. There is also information regarding college entrance and graduation, as well the wages of those in the formal sector. The SIMCE (the System of Quality Measurement in Education, abbreviated to SIMCE by its Spanish name) test is a government-provided, national, mandatory test taken by8th and 10th graders in Chile. The SIMCE includes parent and teacher questionnaires that provide self-reported information for parents' socio-demographic factors such as parental education, family income level, and type of school at-

Figure 1. New Subway Lines: Treatment and Control

Treatment (2005)



Control (2011)



Students are identified by their schools in 8th grade.

Schools around the new subway stations are identified as treatment and control groups

tended, among other factors. The family income and parental education in these questionnaires are used in this paper to estimate the family baseline and controls. The Ministry of Labor provided information detailing the wages of the students between 2015 and 2018 for those employed in the private sector. This data comes from the unemployment insurance systems, where worker have an account that follows them through job changes. The majority of workers are enrolled. However, it does not include workers in the informal sector. The outcome variables is the rank-rank intergenerational mobility of students in which parents and students are both ranked using the full national student cohorts, estimated following Chetty et al. (2014). Parental income was obtained from the 2004 SIMCE survey and the student's adult wage is obtained from their wages in 2016, 2017, and 2018 from the Ministry of Labor. The students in the treatment and control groups correspond to students in middle school in the surrounding areas of the subway lines, totaling 13,802 students. In particular this paper will focus on the middle schools that finished in 8th grade (k-8), totaling 7,055 students, for whom there is wage information for 5,456.[1]

Table 1—Students Analyzed in the Study

	Population	Wage Information
Initial Cohort	249,373	181,912
All Students*	13,802	10,437
Treated and Control**	7,055	5,456

Note:
* All students includes (k-8) and (k-12) schools
** Only (k-8) schools

Table 2 presents the statistics of the main variables for the students and their families.The variables of interest of this study are test scores, income rank, parental education, student education and wages as described in Table 2. It is possible to see that the treatment and control group are very similar in income rank of the parents (treatment 50 v/s control 51), parental educational level (treatment 1.9 v/s control 1.87) and SIMCE test scores (treatment 249 v/s control 245). It's possible to see that Income Child rank is slightly higher for the treatment group (52 vs 51).

C. Methodology

This paper uses a DID approach to estimate the ITT effect of the subway and the potential increase in school choice. The exposed group is defined as students

[1]The study does not focus on student that were in k-12 high schools, as they are not forced to choose another high high school. Therefore, there is an endogenous process there, were only motivated parents and student will take advantage of the subway line, and choose another school

Table 2—Variables of Interest and Sample Size

Treated					
Variable.	Obs.	Mean	Std. Dev.	Min	Max
Income Rank Child	3,610	52	28	0	100
Income Rank Parents	3,610	50	24 0	100	
SIMCE Test Score	3,610	249.27	43.51	130	388
Parental Education Level	3,022	1.9	0.95	1	8
Control					
Variable.	Obs.	Mean	Std. Dev.	Min	Max
Income Rank Child	1,846	51	27	0	100
Income Rank Parents	1,846	51	24	0	100
SIMCE Test Score	1,846	245.07	42.44	129	368.
Parental Education Level	1,535	1.87	0.93	1	8

who attend (k-8) middle schools in the affected areas of the new subway. The control group are students who attended (k-8) middle schools in the proximity areas of the second subway expansion in 2011 after they graduated (Figure 1). Therefore, these individuals had similar positive neighborhood effects of the increase in connectivity, but did not benefit from increased access to different high schools.

The initial formulation follows the literature of intergenerational mobility that uses administrative data sets (Chetty et al., 2014) and its empirical specification is as follows:

$$Y_{1i} = \beta_0 + \beta_1 Y_{0i} + \varepsilon_i \tag{1}$$

Where Y_{i0} is the rank of the family i in 2004, and Y_{i1} the rank of the child i in 2017. To estimate the (ITT) effect using a DID approach, this paper starts with the the empirical specification depicted by equation (1). To run the regressions using a DID approach, the data is transformed into a panel data set. A time measurement variable is created where the period is t, the initial period ($t = 0$) is 2004, and the following period ($t = 1$) is 2017. T_{it} is a dummy variable that indicates the year 2017 and the variable $Exposure_{it} = 1$ indicates the students affected by the subway expansion[2]. The outcome variable will be: $Y_{1i} - Y_{0i} =$ Intergenerational income mobility of Child. The interaction term T_{it} $Exposure_{it}$ will allow for measurement of the shock, and β_3 will be the DID estimate. Equation (3) shows the equation for the DID estimation:

$$Y_{it} = \beta_0 + \beta_1 Exposure_{it} + \beta_2 T_{it} + \beta_3 T_{it} Exposure_{it} + \epsilon_{it} \tag{2}$$

[2]Covariates such as academic performance, parental education are included as controls

This regression then calculates how much of the change in rank is associated with the subway expansion. The DID estimate will measure the change in rank position between the child and their parents, with respect to the control group. To further refine the estimations, different co-founding variables (parental education, SIMCE test scores, family income) are included in the analysis to check the robustness of the estimations. The main hypothesis of this paper is that the increased accessibility of school options will increase the intergenerational income mobility, beyond neighborhood environments. Nevertheless, the channels that could promote social mobility are varied. The first direct channel of transmission could be increased educational quality as measured in standardized tests. Higher test scores have been found to be correlated to increased enrollment in and graduation from tertiary education (Blanco et al., 2018). It can also improve college selection tests scores and college applications, leading to access to better colleges and therefore increased future income (Hastings et al., 2013). There are other channels of transmission, which are related to peers and role models. Role models and peers may affect students' decisions to enroll in higher education or to choose different areas of study that can have different labor market outcomes. This paper also evaluates enrollment rates, graduations rates, and areas of study to analyze these possible channels of transmission.

V. Results

A. Intergenerational Income Mobility

The results of the DID estimation with covariates are included in Table 3, estimating the differences between the income ranking of student and their parental income ranking (see Chetty et al., 2014). The results show that students who were in (k-8) middle schools present an increase in their intergenerational income mobility ranking of 1.8%, with respect to their control group. This increase in intergenerational mobility is robust to different specifications with and without controls, and is equivalent to a 4.7% increase in the wages of the students.

Table 3—DID Regression Results on Intergenerational Income Mobility

	DID	Effect on Wages
DID $\star$	1.83*	4,7%
Observations	9,114	

Note: Author's calculations using diff command in Stata:
$\star$ Parental Income, Parental educational level and SIMCE test scores as controls.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

B. *Channels of Transmission*

As students increased their intergenerational income mobility, it's of interest to analyze the factor that could explain this change. Table 4 shows the results for a series of outcome variables that could explain the increase in intergenerational income mobility. The DID results show that students who were in the (k-8) schools do not present statistically significant changes in their higher education graduation rates. Therefore, it's not evident that increases in graduation explain the higher intergenerational mobility.

Table 4—DID Regression Results: Channels of Transmission

	DID
Higher Education Graduation⋆	0.0132
SIMCE Test Scores⋆	-3.483***
Humanities, Arts and Social Sciences (HASS)⋆	-0.0238***
Observations	9,114

Note: Author's calculations using diff command in Stata:
⋆ Parental Income, Parental educational level and SIMCE test scores as controls.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

The second possible channel that could explain the higher intergenerational mobility is educational quality. To test this possible explanation this paper compares the SIMCE test scores of students in 8th grade to those of students in 10th grade. The DID results in Table 4 show negative results. There are several possible explanations regarding these negative results. The first possible explanation is the socio-emotional and adjustment costs of switching schools (Asahi, 2014; Herskovic, 2020), or that parents choose low quality schools (Abdulkadiroglu, 2013).[3] Although these results are similar with other papers in the literature (Abdulkadiroglu, 2013; Herskovic, 2020) they do not explain the higher intergenerational mobility and suggest that other factors are playing a role.

It's possible that the intergenerational mobility of students is not affected by educational quality as measured by standardized tests, but by "quality" that affects the students' professional paths or fields of study. In Chile, students choose their specific major before entering college, and while higher education is very good investment, some degrees generate higher economic rents than others. In particular, engineering and sciences generate higher future income compared to, humanities, arts and social sciences (HASS), particularly for low income students (SIES 2015). Thus, two different students with the same college selection test

[3]For this case, (Asahi, 2014; Herskovic, 2020) show that actually students are atending "better" schools, when meassuring quality by standardized tests

scores and grades, could have completely different earning if they decide on different paths of study.

This type of thinking is more closely related to the literature on role models and peers having influence on the expectations and desires of students (Hastings et al., 2013). It could be possible that the new schools provide opportunities through guidance, expectations, peer pressure and changed beliefs about the future that are simply not measured in test scores, something that has already been found the literature (Krishna, 2017; Lafortune et al., 2018; Mani and Riley, 2019; Paredes, 2014).

The results in Table 4 shows that treated student attend in a lower proportion (-2.38%) HASS degrees, degrees that are less profitable compared to other areas like health or engineering. If students attend college and vocational degrees that are highly profitable, this could be the channel of transmission of intergenerational mobility. Students seemed to have moved to schools – beyond their neighborhoods- that steered them towards more profitable career paths.

The results in this subsection showed that there are not a higher education graduation factor affecting intergenerational income mobility. Moreover there is a negative "quality" effect measured by the SIMCE tests scores, however, there are changes in the areas of study of the students, leaving low-profitable degrees towards higher income paying career paths. These results generate new research questions, making it relevant to ask if the test scores are the adequate measure to analyze what parents are looking for when analyzing schools, and if researchers should be relying heavily on these scores. The impact of the subway station and school choice policy could be evaluated in the future with the inclusion of previous cohorts of students as controls, students in other geographical locations an in different policy spaces.

C. Robustness Check

This section intends to check the effect of the increase of the treatment on intergenerational mobility. To do so, we extend the analyses to all the schools affected my the subway line, increasing the sample to middle schools that do not close (k-12), but continue as the same institution during high school. Table 6 shows that there is no significant intergenerational income mobility effect for students that assisted schools (k-12) school, but only for the (k-8) schools.

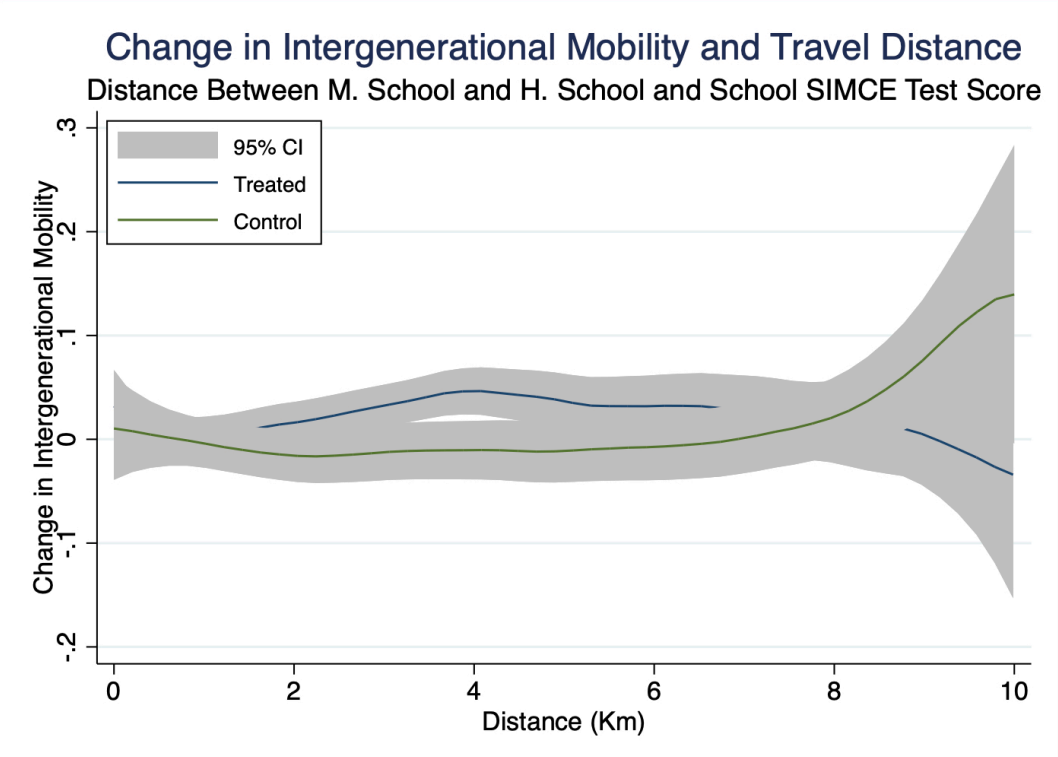
A second robustness check is to analyze the "who" are the student that present intergenerational income mobility. Figure 2 shows the intergenerational income mobility changes for treated and control students (k-8). It's possible to see that treated students traveling between 2-6 kilometers from their middle school of origin to their high school, present a positive average change in their intergenerational mobility, while there is no effect for students traveling closer distances or for the control group.

Table 5—DID Regression Results on Intergenerational Income Mobility

	All Students	K-12 Middle School	K-8 Middle School
DID Estimator	0.637	-0.824	1.83*
Observations	17,418	8,402	9,114

Note: Author's calculations using diff command in Stata:
⋆ Parental Income, Parental educational level and SIMCE test scores as controls.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Figure 2. New Subway Lines: Treatment and Control



VI. Discussion

Low intergenerational mobility, which entrenches inequality, in developed and developing nations warrant an in-depth examination particularly into the factors that could be modified by policy solutions. While neighborhoods have been used as an explanatory factor in the intergenerational mobility literature, they tend to encompass several variables including educational opportunities. This is especially the case in the United States, the study of which tends to dominate the literature. In the context of the high valuation of the neighborhood environment in the current intergenerational mobility debate, it is extremely important to disentangle those variables. Using a quasi-experiment of new subway lines in Chile, this paper analyzes education outside of the neighborhood of residence as a possible policy solution for promoting intergenerational income mobility through reduced transit costs. It builds upon previous research that examined how students used the subway line to travel to high schools beyond their neighborhood Asahi (2014); Herskovic (2020).

Using a DID approach, this paper shows that the subway expansion in the context of a school choice policy increased the intergenerational income mobility of students by two points more than their control group, or a 4.7% increase in their wages. This positive effect is found for students in (k-8) schools, requiring the choosing of a new school high school. The results indicate that intergenerational mobility increases when low-income students have higher availability and are nudged to consider schools beyond their neighborhoods of residence. The analysis of the channels of transmission of the effect show that there is no effect on higher education graduation, and a negative effect on standardized test scores. However, treated students are less likely to enroll in less profitable majors in higher education (i.e. Humanities, Arts or Social Sciences). Moreover, this paper puts into question the use of standardized test scores as the final measure of educational quality, as the results show that treated students have a drop in test scores, but still increase their intergenerational income mobility, which is arguably the aim of public polices and the topic of question for the related literature. These results open space for further debate in the intergenerational mobility arena, as it suggests that education alone can have impacts outside of neighborhood effects, supporting the public policy promotion of school choice measures over the use of policies aimed at changing neighborhood environments like housing vouchers.

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VII. Appendix I

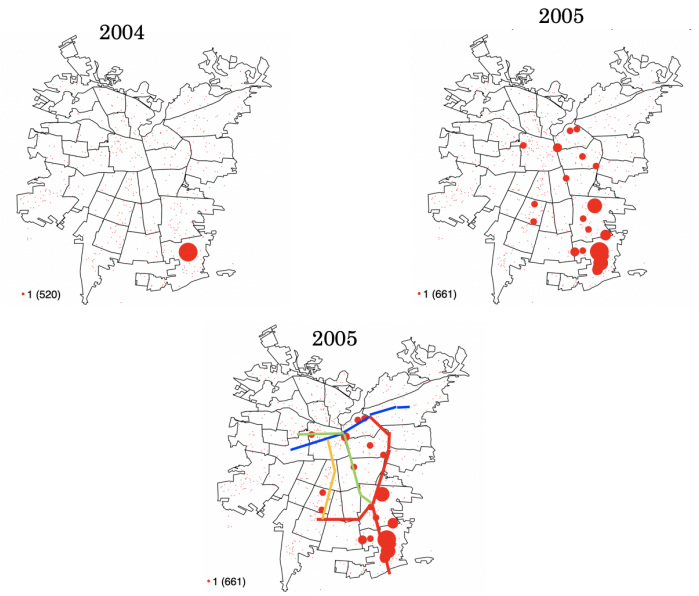
Table 6—Population Affected by New Subway Line 4 and 4A

Name	Population
Puente Alto	491,220
Peñalolen	216,040
La Florida	364,602
Macul	111,914
Nuñoa	162,481
San Ramon	94,906
La Granja	132, 520
Providencia	117,020
Total	1,690,705

VIII. Appendix II

The extension of the subway line allowed students to choose schools all in all of the City of Santiago, increasing their travel distances. The figure bellow show students from a particular Middle School in Puente Alto, and their High Schools one year after.

Figure 3. Example Students in Middle School and High School



The Santiago Subway company, Metro SA has researched extensively the distance travel by indviduals to the subway and from the subway.

Figure 4. Travel Distances from Subway Station

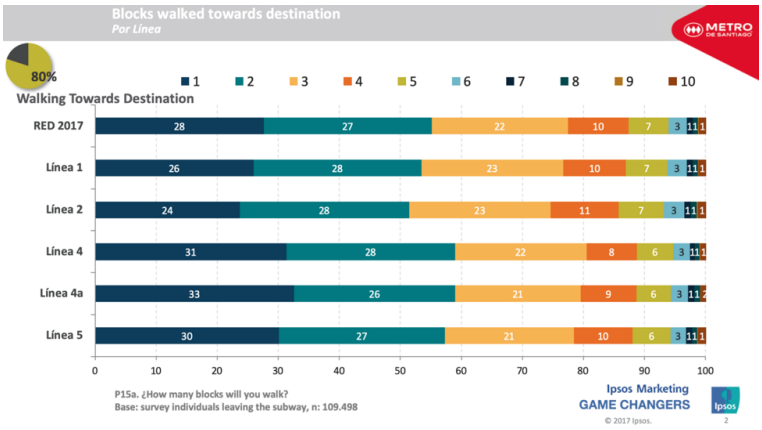
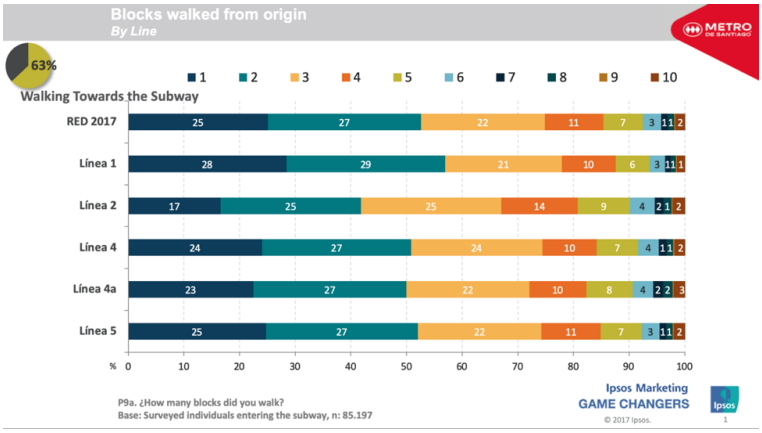


Figure 5. Travel Distances to Subway Station



IX. Appendix III

This paper geocoded a sample of the students' home addresses to analyze if the identification assumption, the middle school of the student, is a reasonable identification strategy. Once students are geocoded, the travel distance to the new subway stations is calculated. The results show that the treated students are on average 1.65 kilometers from the new subway line, with a median of 1.13 kilometers. This results validate the assumption that middle schools close to the new subway station are a reasonable proxy to identify students that live close to the new subway stations.

Figure 6. Travel Distances

Table A1— Distance from Home to Subway Station (Kilometers)

	Median	Mean	SD	N
Students in Treated Middle Schools	1.13319	1.653742	1.840893	3,444

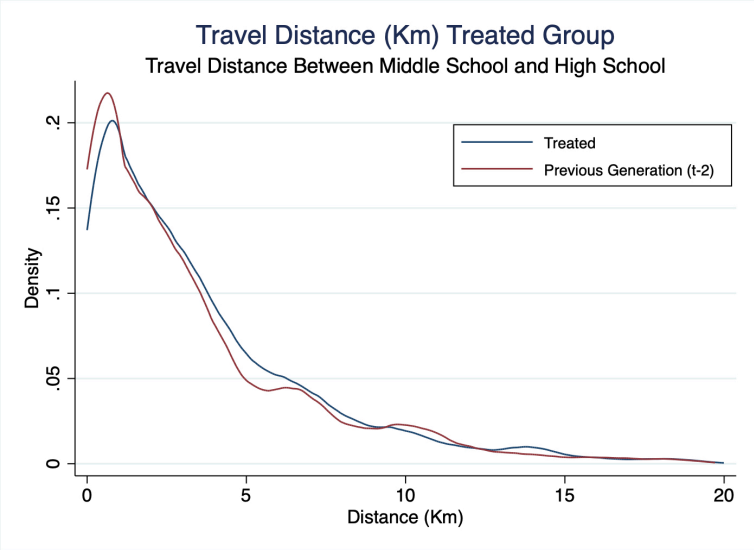
Source: Authors' own work

Figure 7. Travel Distances

X. Appendix IV

This paper corroborates that the subway expansion increased the travel distance of students. The results show that on average, this cohort of students travels 10% longer distances compared with students two years older. This results is consistent with other authors that have found a 6% increase in travel distance due to the new subway line.

Figure 8. Travel Distances



XI. Appendix V

Table 7—Variables of Interest and Sample Size

Variable.	Obs.	Mean	Std. Dev.	Min	Max
Income Rank Child	10,437	0.538	0.2833812	0.0003022	1
Income Rank Parents	13,802	0.575	0.2566679	0.0001003	1
SIMCE Test Score	13,802	255	45.54781	121.245	388.115.
Parental Education (level)	11,470	2.2	1.215	1	8
Students Forced to Switch	13,802	.5049993	0.4999931	0	1
Treatment					
Variable.	Obs.	Mean	Std. Dev.	Min	Max
Income Rank Child	3,610	52	28	0	100
Income Rank Parents	3,610	50	24 0	100	
SIMCE Test Score	3,610	249.27	43.51	130	388
Parental Education Level	3,022	1.9	0.95	1	8
Work 2017	3,610	0.77	0.326	0	1
Control					
Income Rank Child	1,846	51	27	0	100
Income Rank Parents	1,846	51	24	0	100
SIMCE Test Score	1,846	245.07	42.44	129	368.
Parental Education Level	1,535	1.87	0.93	1	8
Work 2017	1,846	0.79	0.324	0	1