

# HUMAN CAPITAL CONCENTRATION IN CHILE

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## Abstract

Chile is one of the most concentrated country in the world. Most of the 40 percent of the population live in the capital city, Santiago, where around 45 percent of the GDP is produced. At the same time, most of the policies promoting welfare are focus on people and they are spatially blind.

This paper shows how the current array keeps concentrating people, especially with potential high human capital, around Santiago, and assesses whether this happened for difference in quality of life and opportunities or difference in the quality of the universities.

The data available on individuals, who end the high school and take the university admission test, that lets students applying to the university and program that they wish to go, allows identifying the region of origin of the students, the region where the university that they apply is located and where they were selected. Three programs are chosen for this study given the quantity of people that apply to them and because they are available across different cities in the country are pedagogy, engineering and physician.

In addition, in Chile they are more than 60 universities, however only the traditional 25 are the one that use this selection system for the period of this study that goes from 2006 to 2009. Recently some new universities have get into the system.

Assuming that most of the students end up working around the city where they got the degree, we use an aggregate discrete choice model to develop a methodology that consist in following the destination of the students who got the best scores in the university admission test. Those students can choose any university in the country, and the majority prefers to go to those in the capital city. Contrasting with these results, lower scores have an inverse pattern.

When we test if it is explained by the difference in the quality of life between cities versus the differences among the quality of the universities, the former has a larger explanatory power, which bring back the discussion if the policy should be oriented to place or people. It means, that will not be enough focus on increase the quality of the universities across the territories to attract better student to universities outside Santiago. It will need and strong complementary policies making those cities more interesting for the potential high human capital applicant.

## Introduction

Chile presents significant concentration around the Metropolitan Region, which is home to over 40% of the nation's population. In addition, nearly 45% of the total GDP is generated in that territory, and over 50% of the country's professionals live in Santiago.

The problem is not one of concentration but rather one of potential overconcentration that would move past optimal levels and the benefits related to agglomeration economies, aggravating existing regional disparities. Atienza and Aroca (2013) show that in recent literature, Chile has been described as a

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country with excessive concentration. This has negative impacts on the country's economic growth and generates differences among the territories' standards of living, which results in an increased resentment in the affected regions and encourages those who live there to use non-institutional routes to call attention to local problems (Armstrong and Taylor, 2985). Recently, Calama, Freirina, Aysén, Punta Arenas, Chiloé and other communities have seen the development of social protest movements that serve as indicators of these regional disparities.

One of the mechanisms of concentration around Santiago is school choice at the university level. Top-scoring secondary school students choose the best universities and/or regions where there are attractive job opportunities and good quality of life. The Metropolitan Region is the territory that meets those conditions. Orsuwan and Heck (2014) show that the likelihood of living in a territory increases when the person has completed their university studies in that region. As such, if the best students outside of Santiago are attracted to that region, one can expect that they will look for work in the capital when they graduate. This attraction of high potential from rural regions is called "brain drain" in the literature.

Following this line of inquiry, this study explores the migration decision that high school students must make when they choose their study program and the region where they will attend college. This is understood as a concentration mechanism for potential qualified human capital. We also explore whether this phenomenon is due to factors that are unique to the territories or differences in the quality of the universities.

Using the discrete choice theory in the context of the maximization of random utility, a model was developed that evaluates the ratio of the aforementioned factors by region of destination over region of origin. In order to estimate this model, a probit was used for aggregate data on the applications of selected students in Engineering, Medicine and Education, who given their characteristics represent the full range of scores.

The results obtained show that as the PSU scores earned by the students selected from the three fields increase, the attributes of the universities such as quality and tuition costs become less relevant for the decision to study outside of one's home region. Rather, these students are attracted by the characteristics of the region, measured as the feasibility of finding a job there.

This study is organized as follows: the next section will provide a brief description of Chile's higher education system and the various experiences in which the "brain drain" problem has been addressed in the United States. Section 3 presents a conceptual framework of the model that will be used to estimate the mechanism of concentration based on student migration. Section 4 describes the data that will be used to illustrate this phenomenon. Section 5 shows the results of the estimate, and Section 6 presents the conclusions.

## **Earlier Experiences and Literature Review**

### **Chile's Higher Education System (MINEDUC, 2012)**

Chile's higher education system is divided into three types of institutions: universities, professional institutes (IP) and technical training centers (CFT). Universities offer undergraduate programs that last for five or more years, as well as master's degrees and doctorates. CFT and IP programs last for two to four years. There are currently 25 universities that belong to the Rector's Council (Consejo de Rectores, CRUCH). These are called "traditional universities" and include both private and public institutions. Chile also has 45 private universities called "non-traditional universities."

When students finish their fourth year of high school, they have the option to register for the University Selection Test (PSU), an admission requirement for some educational institutions that is combined with a score equivalent to the high school grade point average (NEM). The PSU evaluates the knowledge acquired during the four years of high school and includes mandatory Language and Communications and Mathematics tests, as well as optional tests in History and Science (specifically Biology, Chemistry and Physics). The selection of optional tests depends on the program to which the student plans to apply. In 2012, the weighting of the student's rank within their grade level was added to the set of factors considered in the admissions process.

The Department of Student Evaluation, Measurement and Registry (DEMRE) is the institution responsible for the admissions process of the 25 Rector's Council universities and the development, construction and application of the PSU. In 2011, eight private non-traditional universities were added to the institution's admissions process.

In 2006, the Law to Ensure Quality Higher Education was created, which promotes accreditation of higher education institutions and supervises the licensing of new institutions. This law covers issues related to teachers, study programs, economic resources availability and other matters and is meant to ensure that schools are autonomous and able to grant technical or professional degrees. The National Accreditation Council (CNA) accredits institutions, which voluntarily participate in this process in order to certify their quality in terms of infrastructure and the study programs offered.

Universities set their fees for each program on an annual basis, in addition to a tuition paid by each student or guardian. However, there are benefits such as scholarships and credits for students who perform well on the PSU or lack the necessary resources to finance their studies. These benefits are provided by the State or the universities.

### **"Brain drain"**

The brain drain phenomenon has traditionally been related to the attraction of highly qualified human capital from developing countries to developed ones (Gibson & McKenzie, 2011). However, this concept has recently been applied to the analysis of student behavior regarding which institution and territory they choose to complete their advanced studies (Orsuwan & Heck, 2004; Sapra, 2013). It has also been broadened to consider the decisions made by professionals and recent graduates in regard to the territory that is most attractive to them in terms of developing their careers (Kodrzycki, 2001; Ishitani, 2011; Williams and Dreier, 2011).

Within this last line of inquiry, Sapra (2013) studies the decisions made by secondary students in the United States regarding where they enroll in tertiary studies (college). Using data from the Educational Longitudinal Study (ELS, 2002), which contains information regarding where the students who graduate from high school enroll in college, the author shows that better students tend to leave their state of origin and are not likely to return. States with higher high school student emigration rates tend to have brain drain problems because they lose their brightest students.

Ishitani (2011) was the first to engage in the effective monitoring of high school graduates by considering the state in which they decide to continue their studies and then decide to work. This study uses two databases to track individuals: the National Educational Longitudinal Study (NELS: 88/2000) and the Postsecondary Education Transcript Study (PETS, 2000). The latter includes detailed information on the schools from which the NELS respondents graduated. It was found that higher income families are more likely to enroll their children in higher education institutes outside their home states. This is also true for families where both parents have a university degree. Higher levels of per capita income also contribute

to student migration. The likelihood that the student will return after college decreases when the student completes a doctorate and when the region where the university is located has a higher per capita income than the region of origin.

Kodrzycki (2001) explored where college graduates live five years after they finish their studies. Using data from the National Longitudinal Survey of Youth (NLSY), the study determined that individuals migrate for individual reasons rather than labor conditions when they finish their university studies. In other words, their preferences regarding the characteristics of the location (specific job offers, interpersonal relations, etc.) are more important. However, it is vital to note that the cost of housing, salaries, amenities and labor supply are also important factors for these decisions.

The interesting aspect about this study is that it not only analyzes the state of the individual who completes their university education. It also considers the data based on the state where the student finished high school, given that as we have seen, the place where one completes college and high school may vary. This study compares the behavior of the two types of graduates. This is one of the first studies to include amenities and proximity to a coast, average maximum wind speed, average number of sunny days and average number of warm days of each state in addition to variables such as race, gender and state characteristics.

Budgetary restrictions also impact the decision to migrate. Unfortunately, this study does not contain information about this, but articles such as the one authored by Orsuwan and Heck (2004) explore the impact of the implementation of the merit scholarship system on the decision to study in one's state of origin among students who could opt for this type of benefit. If the state of origin implemented these scholarships, the proportion of students who decided to stay increased considerably, given that this was a requirement for accepting the resources. This also caused the emigration rate of the students in the states that implemented the policy to decrease over time. Other authors (Ishitani, 2011; Williams and Dreier, 2011) have studied this sort of financial aid and have reached similar conclusions.

## **Theoretical Framework**

### **Modeling**

In order to better understand this mechanism of concentration, an aggregate model shall be presented based on the total number of high school students who move to different regions of the country in order to attend university. Below we explain how this aggregation is possible based on an individual mode.

When the student decides to enter the higher education system, he or she has a set choice of universities and study programs. This set is limited by the application requirements for each school and program. Given that the set choice limitations do not include geographic criteria, the student not only chooses the institution where they wish to study, but also the geographic place according to its location.

Studying an individual's choice regarding where they will continue their studies involves modeling their preferences in order to analyze how the aforementioned factors can influence them. The consumer theory represents these preferences through functions of utility, which include all the elements that will determine which option is chosen.

The heterogeneity in the unobservable characteristics of the individuals can be problematic. But this is due to the fact that individual preferences or the way in which the different factors come together or how much information one has about the attributes of the universities and regions may vary from one individual to the other. The Random Utility Maximization Model (Marshall, 1960, McFadden, 2001)

takes up this problem by approaching the form of the original utility in a different way, dividing it into a determinate component and a random error:

$$(1) \quad U_{ijn} = V_i(W_n, Z_j, S_j) + \varepsilon_{ij}$$

where  $W_n$  is the individual's set of characteristics,  $i$  is the region of origin and  $j$  the region of destination.  $Z$ s represent the set of characteristics of the regions, such as regional GDP, unemployment rate, quality of life, etc.  $S$ s represent the set of attributes of the university or universities in the regions such as their quality and fees. Finally,  $\varepsilon_{ij}$  is a stochastic error that can have multiple sources (Manski, 1973). The deterministic part reflects the common optimal decision for all individuals, and the random error allows one to reconcile the fact that two optimal decisions of individuals with similar characteristics may be presented as two completely different alternatives.

A dichotomic indicator  $I$  is defined for the decision to study in a region other than the region of origin:

$$I = \begin{cases} 1 & \text{if the person studies in a region other than the region of origin} \\ 0 & \text{studies in the region of origin} \end{cases}$$

In this model, the likelihood of studying in a region other than the region of origin will be equal to the likelihood of the utility that this alternative reports over staying in the region of origin. This process is described in:

$$\begin{aligned} \mathbb{P}(I = 1) &= \mathbb{P}(U_{jn} > U_{in}) \\ &= \mathbb{P}(V_{jn} + \varepsilon_j > V_{in} + \varepsilon_i) \\ &= \mathbb{P}(\varepsilon_i - \varepsilon_j < V_{jn} - V_{in}) \end{aligned}$$

Where the expression of the original utility was replaced and the stochastic part of the determinist was organized. Then, the likelihood that an individual will study in a different region can be represented as:

$$(2) \quad \mathbb{P}(I = 1) = F(V_{jn} - V_{in})$$

where  $F$  measures the behavior of the random errors. The decision to choose a region other than the region of origin shall be evaluated by the differential between the utilities reported by the characteristics of the regions and the attributes of the universities. Assuming that the individual characteristics may be separated, they have an additive form in the function of utility<sup>3</sup> and are invariants in the evaluation of which region to choose to study. By conducting the differential between the indirect utilities, this factor is naturally removed, so the decision to choose a region where to study will be made based on the characteristics of the regions and the attributes of the universities (3).

$$(3) \quad \mathbb{P}(I = 1) = F(V_j - V_i)$$

### Contrast of Hypothesis

In order to prove the hypothesis of this work, the Aroca and Hewings (2002) methodology will be used. Migration matrixes (Table 3.1) will be created that relate the region of origin and the destination and estimate the likelihood of studying in a region other than the region of origin. We will use an aggregate

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<sup>3</sup> In other words, the decision to study in a different region is independent of individual factors such as age, gender and the networks that the student may have.

model to study how the factors assessed influence migration among regions. For this, we will add the individual probabilities in order to calculate the fraction of individuals who migrate. In that aggregation, it is important to assume that the individual utilities are independent.

**Table 3.1. Migration Matrix**

$j/i$	Region of Origin
Destination Region	$M_{ij}$
$M_i = \sum_j M_{ij}$	

Given that the data used to estimate the probability of studying in a region other than the region of origin represent all applicants within the analyzed period, the information is censal in nature. Based on these data, it is possible to calculate the empirical likelihood as the ratio between the people who choose to study in a region  $j$  and the total of the region of origin.

$$(4) \quad \frac{M_{ij}}{M_i} \approx \widetilde{P}_{ij} \quad \forall j$$

This ratio (4) is found in the migration matrix, as each  $M_{ij}$  cell represents all the applicants from region  $i$  who migrate to region  $j$ .  $M_i$  are all the applicants who belong to a region of origin  $i$ . Integrating the approximate to (3), the probability is shown as:

$$(5) \quad \widetilde{P}_{ij} = F(V_j - V_i)$$

Where the empirical probability for grouped data is equal to the initial function for each individual.

Returning to the migration matrix, each  $M_{ij}$  cell represents a homogeneous subgroup of the total population. This definition allows using the Berkson method (Ameniya 1985, Ben-Akiva and Lerman, 1985) for the estimation of the model under minimum weighted squares. As  $F$  is a function of accumulated distribution, it is possible to invert it, leaving it as:

$$(6) \quad F^{-1}(\widetilde{P}_{ij}) = V_j - V_i = \alpha \left( \frac{Z_j}{Z_i} \right) + \beta \left( \frac{S_j}{S_i} \right) + \varphi$$

Where the differential of the utilities can be lineally approximated as a Taylor series and  $\alpha$  equals the coefficients that explain the characteristics of the regions and  $\beta$  the attributes of the universities plus an  $\varphi$  error. This method will cause the proportion of each  $M_{ij}$  cell to be used for the estimation of the likelihood of choosing a region to study.

Assuming that the errors are independent from one another, the sum of these by central theorem limit approaches a normal distribution. This allows using the following probit model:

$$(7) \quad \Phi^{-1}(\widetilde{P}_{ij}) = V_j - V_i = \alpha \left( \frac{Z_j}{Z_i} \right) + \beta \left( \frac{S_j}{S_i} \right) + \varphi$$

## Data and Stylized Facts

### Applications

In order to explore how students choose which program/university they wish to be accepted in, it was necessary to design a system that shows the preferences of the applications and integrates the individuals' specific characteristics.

The data to be used represents the admissions processes of the universities that were part of the Rector's Council between 2007 and 2009. The sample contains information for 1,323,475 applications. The data includes the student's preferences regarding study programs, the university that accepted the student and the universities to which the person applied, the person's region of origin (in this case linked to the high school where they studied), the weighted score earned and at a disaggregated level for each test, plus the high school grades (NEM) score and the grade point average upon graduation. The data also includes information regarding the high school that the student attended, individual characteristics of their socio-economic level, family information, and the location of the applicant's domicile.

For the period analyzed, a total of 950, 952 and 942 programs were offered by the universities, respectively. Each institution's offer ranges from 18 to 86 programs. However, in this article we will only consider three programs: Medicine, Engineering and Education. Annexes A, B, C and D present the data for each program by number of applicants, number of students accepted and the PSU score limit that would reflect the students' ability. Given that Chilean universities offer various types of engineering and education programs, these study programs were unified under a single name for each field.

Tables 4.1, 4.2 and 4.3 show the average PSU score of the applicants, selected students and selected students from outside the Metropolitan Region by year, as well as the standard deviation and minimum and maximum score selected for the programs. The type of students that each program captures is clear from the data. Note that the average score of the selected students for each study program drops nearly 10 points when students from Santiago are excluded.

**Table 4.1. Medicine**

Year	PSU Average Applicants	PSU Average Admitted	PSU Average Admitted (from non MR)	SD	PSU Min	PSU Max
2007	671,80	751,50	746,22	24,14	706,7	826,2
2008	674,18	752,89	746,31	26,44	710,2	827,9
2009	673,69	754,43	749,09	26,34	706,9	823,5

Generated by the author using data from DEMRE.

**Table 4.2. Engineering**

Year	PSU Average Applicants	PSU Average Admitted	PSU Average Admitted (from non MR)	SD	PSU Min	PSU Max
2007	586,65	607,79	594,80	69,67	415,5	830,7
2008	588,61	606,62	595,14	70,58	414,2	835,4
2009	586,61	611,56	600,30	68,26	450	833

Generated by the author using data from DEMRE.

**Table 4.3. Education**

Year	PSU Average Applicants	PSU Average Admitted	PSU Average Admitted (from non MR)	SD	PSU Min	PSU Max
2007	548,76	575,76	566,79	46,70	432,4	764,3
2008	549,50	571,72	562,45	46,89	428,4	792,4
2009	549,99	574,34	656,79	45,50	420,8	749,3

Generated by the author using data from DEMRE.

For Medicine, the applicants with the highest scores are admitted and there is a small variation among the scores. For Engineering, the variation can be explained by the number of study programs offered by each school. However, the average score is over 600 points for the students selected and there are students with top national scores who apply to these programs. Given the inclusion of all programs under the heading of Engineering and observing the average, maximum and minimum scores of the selected students, it is the study program that best represents the distribution of scores. These programs can capture students with scores between 500 and 550 points, as well as students with the highest scores (750 to 850 points).

The case of Education is similar to Engineering because it covers all types of programs linked to that field. However, the deviations are smaller than those observed for Engineering and the average for selected students is under 600. In addition, for the period observed, no selected students had a weighted score over 800, unlike in the case of Engineering and Medicine.

### Quality

In this case, using quality indexes that contain information on the selection of students, for example, the average PSU score data of the students enrolled in a university, is problematic because the endogeneity of these decisions would contaminate the estimates of the empirical model. As such, in order to integrate the quality of education into the model, the indicators should reflect the level of teaching and research and the relationship with the surroundings of each institution. In other words, they should be quality indexes that are not affected by the students' decision to enroll in a specific institution.

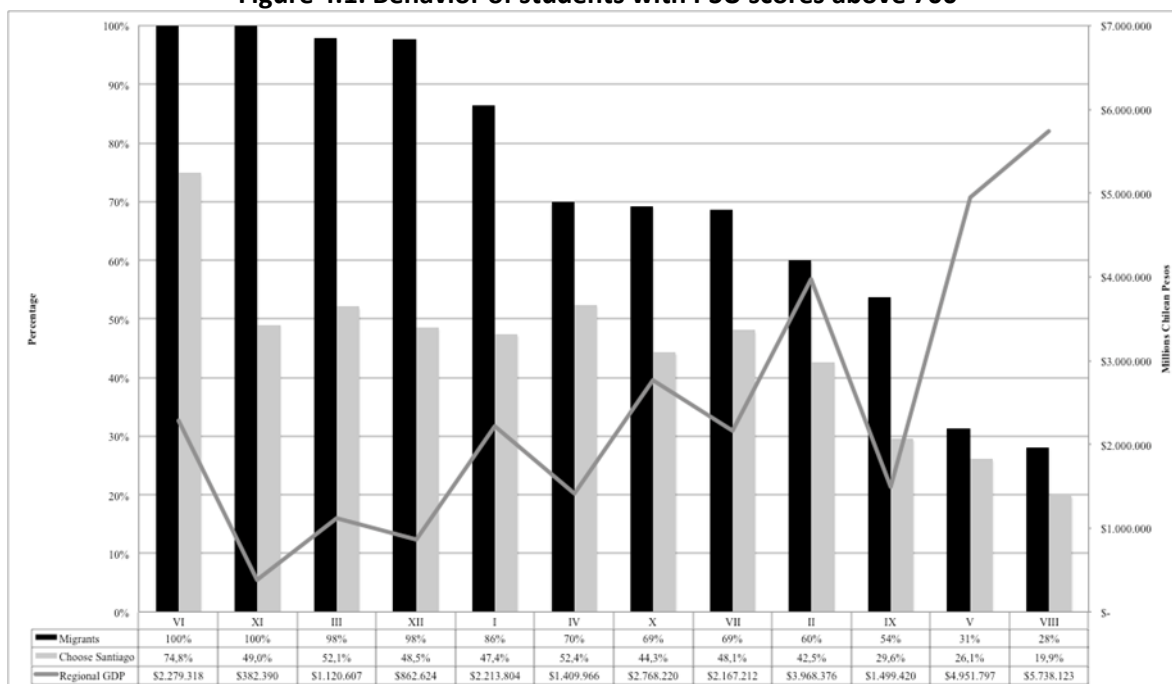
In Chile, this data is collected by the National Accreditation Council during the accreditation processes of each school. The information for the Rector's Council universities was gathered considering the years for which they were accredited during the period analyzed and the areas in which they were accredited. Information obtained from the National Council on Education was also used, including tables that contain data such as the fee structure of the programs by university.

### Localization

In order to determine the effect of each region's characteristics, data from the 2006 National Socio-economic Characterization Survey (CASEN) was used. Researchers used data on the main occupation's income for each type of program analyzed, that is, for engineers, doctors and teachers. This is because when a person chooses a program, he or she thinks about how much a professional in that field will earn.



**Figure 4.1. Behavior of students with PSU scores above 700**



Developed by the author using DEMRE data.

In addition, the number of persons working per one million inhabitants was obtained for each region. This will serve as a proxy for identifying the territories with greater opportunities for finding work. The quality of life was determined based on the work of López and Aroca (2012), where they estimate the inflation of housing prices in various regions. This data allows exploring region characteristics such as amenities and cost of living.

### Student Movement in Various Regions

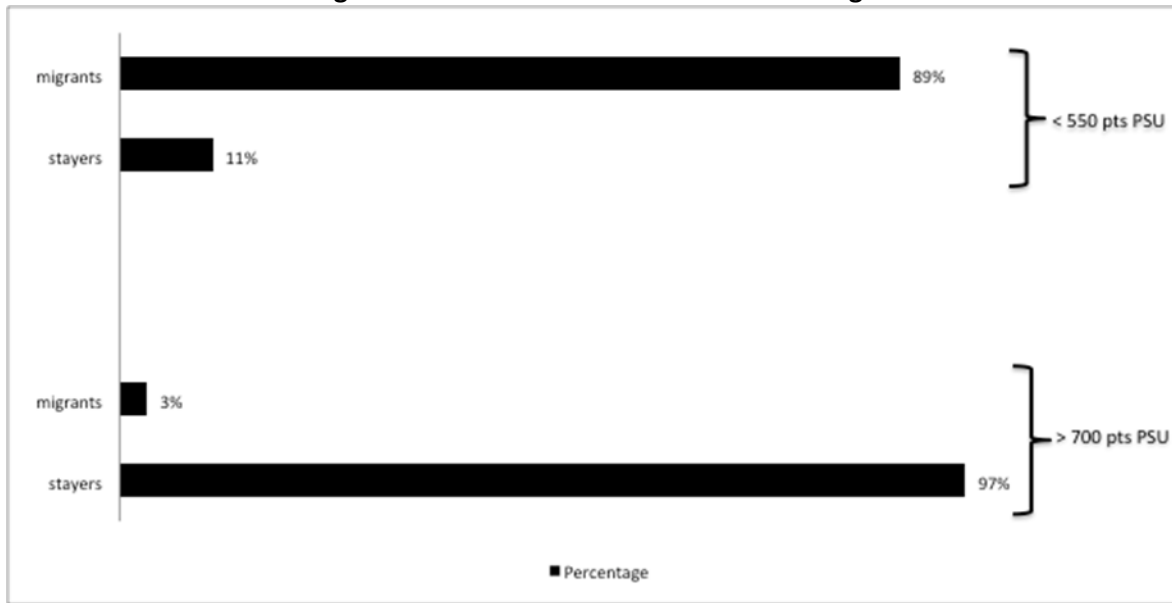
Figure 4.1 shows the percentage of students who obtained scores above 700 on the PSU in regions other than the capital and who migrated from their region of origin. It also shows how many of those students choose the Metropolitan Region to develop their talents and receive professional training. The line represents the regional GDP. It is easy to see that as regions generate more resources, migration decreases. We will consider which aspect of regional development decreases the likelihood of studying in a region other than the region of origin in greater detail.

For example, Regions V and VIII have the greatest regional GDP outside of the Metropolitan Region and the smallest percentages of migrants. From these, fewer than 30% choose to live in Santiago. This may be due to the fact that the quality of their universities is comparable to that of Santiago. Top universities in these regions include Universidad Técnica Federico Santa María, Universidad de Valparaíso and Universidad de Concepción, respectively. The opposite is true for students who earn scores below 550 on the PSU. These students tend to stay in their region of origin. Of those who migrate, less than 2% from each region head to Santiago.

On the other hand, the Metropolitan Region (Figure 4.2) presents results that “mirror” those presented above. Of those who obtain a score of 550 or lower, 89.4% migrate to other regions (with 97% staying in

Santiago, Fig. 4.1). In other words, students from rural areas who earn high scores go to Santiago, while those who obtain low scores in the capital migrate to other regions.

**Figure 4.2. Behavior of students from Santiago**



Developed by the authors using DEMRE data.

This reorganization of students implies that a great majority of students with high scores end up studying in Santiago. As we noted before, it is quite likely that they will remain there once they finish their studies. Rural regions receive students with lower scores who may enter their job markets. This process increases the disparity in the distribution of students with high potential and favors their concentration in the capital.

## Model Estimate

### General Results

The following section describes the results obtained from the estimates for Engineering, Education and Medicine programs. Again, the equation for the estimate is:

$$\Phi^{-1}(\widetilde{P}_{ij}) = V_j - V_i = \alpha \left( \frac{Z_j}{Z_i} \right) + \beta \left( \frac{S_j}{S_i} \right) + \varphi$$

Where  $Z$ s represent the unique characteristics of the region and  $S$ s the attributes of the universities. The ratio between the region of destination and the region of origin is evaluated for each variable.

The regression is estimated with the following controls: *Housing prices* as an approximation of the cost of living in the regions; *Main Occupation Income* as an approximation of the expected income for those who graduate from each type of program; *Number of Employed Individuals*, measured to examine the feasibility of being hired in a region; *Tuition Fees* as an approximation of the cost of enrolling in a program; and *Maximum Accreditation* as the best institutional quality option the student will have access to. These controls allow exploring the factors associated with migration flows, presenting an estimate that includes Santiago as a destination region.

Finally, the marginal effects calculated as the elasticities associated with each variable over the difference between the regions evaluated are presented in order to elucidate the influence of the factors analyzed on the likelihood of studying in a region other than one's region of origin.

**Table 5.1 Estimated Model**

VARIABLES	Education		Engineering		Medicine	
	(1)	(2)	(3)	(4)	(5)	(6)
	>450	>550	>600	>650	>720	>740
Housing Price	-0.0415 (0.322)	-0.609 (0.408)	0.138 (0.385)	1.089* (0.561)	-0.285 (0.391)	0.622 (0.746)
Main Occupation Income	0.743 (0.453)	0.864 (0.541)	0.355 (0.278)	0.666* (0.342)	-0.0882 (0.129)	0.181 (0.232)
Number of Employed Individuals	-0.0224 (0.0181)	-0.00720 (0.0187)	0.0160** (0.00655)	0.0163* (0.00830)	0.0517*** (0.0113)	0.0490*** (0.0169)
Tuition Fees	-0.362* (0.185)	-0.586** (0.227)	-1.106 (0.901)	-1.837 (1.146)	1.247 (0.825)	1.259 (1.177)
Maximum Accreditation	0.643*** (0.163)	0.765*** (0.191)	0.722*** (0.188)	0.692*** (0.242)	-0.0318 (0.551)	-0.535 (0.926)
Constant	-3.311*** (0.395)	-2.742*** (0.468)	-2.513*** (0.854)	-2.733** (1.089)	-2.887*** (0.695)	-3.419*** (1.007)
Observations	107	96	94	62	42	25
R <sup>2</sup>	0.204	0.275	0.379	0.483	0.650	0.713

Standard Errors in Parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results of the model estimation are presented in Table 5.1. The table presents data obtained for Education, Engineering and Medicine, organized as described above in order to represent the best score distribution for the characteristics of each program. The estimate was conducted for various cohorts of scores, but only the most illustrative for each program are presented here.

As one can see, as the PSU score in the estimate increases, the characteristics linked to the quality of the universities (fees and maximum accreditation) cease to be relevant. As such, for students with low scores, the decision to study in a different region depends on the quality and cost of the program. For medium scores, both regional and institutional characteristics are important when making the decision to migrate. In this case, the cost ceases to be relevant. Finally, for those who earn the highest scores, only factors associated with the location, measured as the feasibility of being hired, can explain movement to regions where these characteristics are more attractive.

## Marginal Effects

This section presents the marginal effects associated with the estimate for each program type. These effects are calculated as elasticities associated with the controls in order to analyze the impact of the 1% increase on the factors and explore the influence this percentage change can have on the likelihood of studying in a different region.

Table 5.2 shows the marginal effects for each program type and variable associated with the regional characteristics and attributes of the universities. One can see that both quality and cost are sensitive to any change in these variables. For both low and high scores, the expected income and cost of living in the region are also elastic in their marginal change, though they are much less significant (90%).

The feasibility of being hired, which is a measurement linked to the characteristics of the place, turns out to be inelastic for those with high scores and a percentage of those with medium scores, though when its coefficient increases, the score “gains” elasticity. In other words, even if the conditions are improved in the other regions where this measure is not so attractive, the mitigation of the concentration, for example, in the Metropolitan Region where this measurement is better, will only be observed in the long term.

**Table 5.2 Marginal Effects**

VARIABLES	Education		Engineering		Medicine	
	(1)	(2)	(3)	(4)	(5)	(6)
	>450	>550	>600	>650	>720	>740
Housing Price	-0.114 (0.886)	-1.663 (1.119)	0.363 (1.009)	2.311* (1.208)	-0.671 (0.926)	1.240 (1.488)
Main Occupation Income	2.045* (1.243)	2.327 (1.455)	0.940 (0.734)	1.495* (0.774)	-0.262 (0.387)	0.476 (0.605)
Number of Employed Individuals	-0.162 (0.138)	-0.0510 (0.134)	0.140*** (0.0512)	0.158** (0.0708)	0.396*** (0.0817)	0.460*** (0.150)
Tuition Fees	-1.030* (0.537)	-1.641** (0.663)	-2.766 (2.260)	-3.991 (2.514)	2.809 (1.866)	2.427 (2.289)
Maximum Accreditation	1.896*** (0.474)	2.282*** (0.560)	2.046*** (0.517)	1.802*** (0.599)	-0.0741 (1.283)	-1.121 (1.957)
Observations	107	96	94	62	42	25

Standard Errors in Parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Conclusions

The goal of this study was to elucidate the factors that influence migratory flows of students from one region to another in order to explain one of the causes for the concentration of qualified human capital in Chile. The estimate of the models shows that the characteristics associated with the regions,

measured as the expected income of the students, cost of living and feasibility of being hired in a region, consistently affect the likelihood that the individuals with good scores will study in a region other than their home region more than the factors associated with the quality of education.

The comparison between Engineering and other majors allowed us to observe the heterogeneities between the migratory flows of these three types of students. As we noted, Engineering is most representative of the population because when we standardize all the types of programs in this field it covers selected students with low scores as well as an important number of students with the best scores for the years considered. This made it possible to compare the heterogeneity within a single field and compare it to Education and Medicine.

In addition, given the changes that have taken place in the regulations regarding higher education institutions and the increase in the quality of the universities, those who are selected with low scores and a portion of those with middle scores may decide to study in a different region. If higher education becomes free, only those with low scores will change their behavior, gaining the opportunity to migrate in order to study in a different region.

The results of the model estimate suggest that policies aimed at the best students, such as tuition scholarships designed to keep those individuals in their regions of origin, will not mitigate the concentrating effect in Santiago. This is due to the fact that, based on the estimates, factors linked to the place are more important to them. As such, in order to mitigate the concentration of human capital, incentives and the improvement of the conditions in these territories must be considered, as should the improvement of job opportunities and the offer of basic services in regions outside the capital.

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## Anexos

### Anexo A

**Tabla A.1. Datos de estudiantes seleccionados entre 2007 - 2009**

<i>j / i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	5622	574	153	262	271	802	198	106	146	44	52	7	10	8247
II	612	6813	580	802	296	701	175	107	128	39	49	9	12	10323
III	22	48	1428	234	75	142	82	27	31	14	11	2	1	2117
IV	80	139	581	4824	227	529	156	40	46	20	26	9	8	6685
V	577	503	451	1113	18659	6887	3172	794	333	263	806	167	326	34051
RM	392	387	259	572	1162	39092	2317	1153	692	425	833	81	179	47544
VI	3	3	3	7	53	267	273	16	5	0	1	3	2	636
VII	13	7	9	13	28	305	1341	5756	304	23	26	5	12	7842
VIII	133	122	84	124	433	2062	1056	2494	25850	818	835	202	148	34361
IX	37	36	22	60	154	1072	369	250	1144	8882	1221	231	83	13561
X	32	38	22	61	210	1132	226	164	388	709	7596	251	183	11012
XII	2	4	9	21	61	314	53	49	42	28	113	85	1239	2020
	7525	8674	3601	8093	21629	53305	9418	10956	29109	11265	11569	1052	2203	178399

Elaboración propia con datos DEMRE

Anexo B

**Tabla B.1. Datos de postulantes a Medicina entre 2007-2009**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
II	331	782	99	120	136	224	46	67	71	33	39	6	12	1966
IV	87	92	64	313	119	144	30	36	33	11	16	3	10	958
V	219	148	94	174	1990	1396	282	179	178	85	158	25	67	4995
RM	306	275	127	248	790	7327	522	477	472	251	323	27	89	11234
VII	44	32	17	28	112	342	280	1079	272	61	79	13	15	2374
VIII	170	124	44	75	283	856	209	472	2879	325	346	29	88	5900
IX	40	26	19	16	80	311	47	80	358	1087	299	26	49	2438
X	70	50	28	33	201	618	113	141	324	534	1284	54	135	3585
	1267	1529	492	1007	3711	11218	1529	2531	4587	2387	2544	183	465	33450

Elaboración propia con datos DEMRE

**Tabla B.2. Datos de seleccionados a Medicina entre 2007-2009**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
II	25	90	4	4	12	12	2	5	7	1	0	2	2	166
IV	8	7	15	81	32	21	8	4	6	2	2	2	2	190
V	8	5	3	3	199	61	13	3	1	0	1	0	0	297
RM	18	32	8	29	44	615	60	37	34	25	25	0	5	932
VII	3	2	1	1	4	11	40	81	24	8	3	0	0	178
VIII	5	8	1	2	11	28	9	42	327	7	22	1	2	465
IX	1	0	1	0	2	3	1	1	14	134	10	0	0	167
X	1	2	1	1	5	13	5	4	5	18	111	1	11	178
	69	146	34	121	309	764	138	177	418	195	174	6	22	2573

Elaboración propia con datos DEMRE

**Tabla B.3. Datos de seleccionados a Medicina entre 2007-2009 con puntajes sobre 735 puntos PSU**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
II	5	23	1	1	0	0	1	0	1	0	0	0	0	32
IV	1	3	3	25	1	2	2	0	0	0	0	1	0	38
V	7	3	3	3	139	29	8	2	1	0	0	0	0	195
RM	18	32	8	29	44	615	60	37	34	25	25	0	5	932
VII	0	0	0	0	0	0	3	32	2	0	0	0	0	37
VIII	3	8	1	2	8	24	9	35	261	5	17	1	2	376
IX	0	0	0	0	0	2	0	0	6	93	5	0	0	106
X	0	2	1	1	3	5	4	3	4	3	78	1	10	115
	34	71	17	61	195	677	87	109	309	126	125	3	17	1831

Elaboración propia con datos DEMRE

Anexo C

Tabla C.1. Datos de postulantes a Ingeniería entre 2007-2009

$j/i$	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	5911	688	134	163	139	404	119	70	66	39	47	5	7	7792
II	903	9059	885	934	256	620	175	87	113	47	54	12	4	13149
III	89	154	2559	369	148	247	146	55	59	28	21	4	3	3882
IV	117	372	931	6285	245	577	222	66	45	18	29	10	15	8932
V	758	766	521	1084	2354	68497	4208	2109	1340	822	1417	237	258	84371
RM	1541	1316	1224	2465	28499	12391	6049	2297	1191	766	2221	388	660	61008
VI	2	1	2	6	16	354	118	14	6	3	1	4	0	527
VII	18	10	11	20	47	423	1461	7884	213	26	29	12	22	10176
VIII	228	243	145	196	416	2372	1365	3317	38558	1649	1633	373	224	50719
IX	67	48	34	62	135	1038	287	220	1234	14105	1805	315	99	19449
X	61	55	22	72	219	949	214	208	435	957	8554	338	159	12243
XII	7	3	1	9	11	33	7	12	17	8	34	31	796	969
	9702	12715	6469	11665	32485	87905	14371	16339	43277	18468	15845	1729	2247	273217

Elaboración propia con datos DEMRE

Tabla C.2. Datos de seleccionados a Ingeniería entre 2007-2009

$j/i$	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	1341	97	16	33	30	112	20	22	13	4	5	1	0	1694
II	194	2438	206	236	55	181	43	21	28	8	10	3	1	3424
III	13	22	494	59	25	55	34	12	11	6	3	0	0	734
IV	12	33	148	1235	35	96	29	5	4	1	3	1	2	1604
V	262	211	164	407	4787	1549	975	348	123	146	386	59	122	9539
RM	93	89	67	131	255	9680	607	286	185	112	227	26	35	11793
VI	0	0	0	0	4	92	29	3	2	0	0	2	0	132
VII	1	1	2	0	5	55	250	1456	25	1	1	0	3	1800
VIII	22	21	15	19	47	313	185	496	6673	212	218	56	23	8300
IX	7	7	4	9	22	254	45	32	236	2802	279	59	18	3774
X	9	7	5	16	45	235	29	43	87	170	1970	74	26	2716
XII	1	0	0	6	1	13	0	6	2	1	13	13	257	313
	1955	2926	1121	2151	5311	12635	2246	2730	7389	3463	3115	294	487	45823

Elaboración propia con datos DEMRE



**Tabla C.3. Datos de seleccionados a Ingeniería entre 2007-2009 con puntajes sobre 700 puntos PSU**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	15	0	0	0	0	0	0	0	0	0	0	0	0	15
II	2	26	2	1	0	0	0	0	0	0	0	0	0	31
III	0	1	2	0	0	0	0	0	0	0	0	0	0	3
IV	0	0	0	5	0	0	0	0	0	0	0	0	0	5
V	33	36	16	32	355	22	47	58	16	62	79	4	17	777
RM	39	48	21	58	85	2502	228	136	98	73	137	13	17	3455
VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VII	0	0	0	0	0	0	1	20	0	0	0	0	0	21
VIII	1	1	0	1	0	4	3	25	340	22	22	3	2	424
IX	0	0	0	0	0	2	0	0	0	47	1	1	0	51
X	0	0	0	0	0	1	0	1	1	5	26	0	1	35
XII	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	90	112	41	97	440	2531	279	240	455	209	265	21	37	4817

Elaboración propia con datos DEMRE

#### Anexo D

**Tabla D.1. Datos de postulantes a Pedagogía entre 2007-2009**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	5533	673	173	272	206	512	256	106	173	59	55	3	6	8027
II	151	3604	344	445	212	312	174	115	108	22	34	5	3	5529
III	24	56	1398	215	56	78	71	11	28	7	12	1	0	1957
IV	137	397	1128	8389	376	771	364	129	77	31	89	23	9	11920
V	392	465	471	1352	28	10257	5354	1431	629	256	841	229	238	21943
RM	211	146	136	311	990	39120	2739	1046	475	292	527	75	71	46139
VI	0	1	0	0	9	329	248	8	5	2	4	0	0	606
VII	13	11	9	17	62	372	1878	9422	342	40	54	16	13	12249
VIII	120	95	62	145	425	2026	1993	4529	37314	1205	1005	231	118	49268
IX	19	17	12	44	156	1072	457	388	1713	12347	2190	338	89	18842
X	32	34	19	58	225	805	482	223	499	772	10310	319	127	13905
XII	5	4	4	21	91	275	100	48	60	36	161	84	1218	2107
	6637	5503	3756	11269	2836	55929	14116	17456	41423	15069	15282	1324	1892	192492

Elaboración propia con datos DEMRE

Tabla D.2. **Datos de seleccionados a Pedagogía entre 2007-2009**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	1059	109	33	53	53	145	60	25	32	12	9	0	4	1594
II	19	829	72	107	54	76	40	25	31	3	4	0	0	1260
III	1	6	270	63	7	18	12	1	7	3	1	0	0	389
IV	17	25	120	1166	24	115	37	10	12	4	8	0	0	1538
V	51	50	42	145	3558	1436	726	121	39	22	88	29	31	6338
RM	25	17	12	30	59	4744	277	95	38	18	52	5	8	5380
VI	0	1	0	0	0	75	57	0	1	0	0	0	0	134
VII	1	2	1	2	2	39	257	1219	21	2	2	2	2	1552
VIII	12	8	5	8	28	207	186	585	4746	102	89	15	8	5999
IX	3	1	0	5	18	204	75	68	257	2102	382	76	17	3208
X	4	4	2	3	25	109	64	18	52	43	1517	30	9	1880
XII	0	0	2	5	14	110	23	18	9	5	31	25	282	524
	1192	1052	559	1587	3842	7278	1814	2185	5245	2316	2183	182	361	29796

Elaboración propia con datos DEMRE

Tabla D.3. **Datos de seleccionados a Pedagogía entre 2007-2009 con puntaje sobre 650 puntos PSU**

<i>j/i</i>	I	II	III	IV	V	RM	VI	VII	VIII	IX	X	XI	XII	
I	13	0	0	0	0	0	0	0	0	0	0	0	0	13
II	0	14	0	0	0	0	0	0	0	0	0	0	0	14
III	0	0	3	0	0	0	0	0	0	0	0	0	0	3
IV	1	1	5	37	0	2	1	0	0	0	0	0	0	47
V	6	10	5	6	173	18	26	7	2	3	9	5	4	274
RM	8	2	5	6	14	674	55	22	6	2	14	2	3	813
VI	0	0	0	0	0	0	1	0	0	0	0	0	0	1
VII	0	0	0	0	0	0	3	28	1	0	0	0	0	32
VIII	0	1	0	0	0	1	3	18	113	1	7	2	0	146
IX	0	0	0	1	0	2	0	0	1	35	13	0	2	54
X	0	0	0	0	0	1	1	1	0	4	46	2	1	56
XII	0	0	0	1	0	0	0	0	0	0	0	0	7	8
	28	28	18	51	187	698	90	76	123	45	89	11	17	1461

Elaboración propia con datos DEMRE

Anexo E

**Tabla G.1 Latin American countries with excess of concentration**

Paper	Primacy index	Latin American countries with excess of concentration	Estimation method
Henderson (2000)	Primacy 1	<i>Argentina, Chile, Uruguay, Paraguay, Peru, Panama, Costa Rica, El Salvador, Nicaragua, Guatemala.</i>	Panel Data
Henderson (2003)	Primacy 1	<i>Argentina, Chile, Mexico, Peru</i>	Panel Data
Bernitelli and Strobl (2007)	Primacy 1	<i>Argentina, Chile, Uruguay, Paraguay, Peru, Costa Rica, El Salvador, Nicaragua, Guatemala, Honduras</i>	Semi-parametric estimation
Brulhart and Sbergami	Primacy 1 and primacy > 750,000	<i>Argentina, Chile, Peru, Uruguay, Venezuela</i>	Panel Data
Pholo Bala (2009)	Primacy 1 and density > 750,000	<i>Argentina, Chile, Dominican Republic, Guatemala, Nicaragua, Peru, El Salvador</i>	Semi-parametric estimation

**Fuente: Atienza and Aroca (2013)**