ABSTRACT

Intersected Inequalities:
How Full Funding for Low-income Students Impacted Class and Gender Disparities in Undergraduate University Programs

Alonso Octavio Aravena Méndez, M.A.

Mentor: Jerry Park, Ph.D.

This thesis provides support on how measures to decrease income inequality can affect class and gender disparities in access and retention within higher education by studying effects of the Chilean 2015 National Education Reform. Beginning in 2016, the Chilean government granted full tuition subsidies for students in higher education who come from the 50% lowest income households in the country. Analyzing undergraduate degree programs and whether they were imparted before or after implementation of the reform, as well as if they were taught at universities participating in the benefit initiative or not, a positive effect was found on both the total percentage of students coming from public high schools and the ratio of females to males in incoming cohorts. University participation being mostly related to institutional accreditation, findings imply that access for underrepresented groups at higher quality universities and higher prestige academic fields has improved in the period after 2015.

Intersected Inequalities:
How Full Funding for Low-income Students Impacted Class and Gender Disparities in Undergraduate University Programs

by

Alonso Octavio Aravena Méndez, B.A., M.A.

A Thesis

Approved by the Department of Sociology

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F. Carson Mencken, Ph.D., Chairperson

Submitted to the Graduate Faculty of
Baylor University in Partial Fulfillment of the
Requirements for the Degree
of

Master of Arts

Approved by the Thesis Committee

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Jerry Park, Ph.D., Chairperson

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Jeremy Uecker, Ph.D.

_____

Juan Carlos, Ph.D.

Accepted by the Graduate School

August 2020

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J. Larry Lyon, Ph.D., Dean

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

# ACKNOWLEDGMENTS

I wish to express my deepest gratitude to Dr. Jerry Park for his invaluable mentoring, encouragement and guidance through this process. I would like as well to recognize the kindness and selflessness of Dr. Jeremy Uecker and Dr. Moises Park in providing their input to bring this thesis to completion. I am also indebted to Dr. Christopher Pieper and Dr. Juan Carlos Esparza, whose meaningful advice has allowed me to find many paths to success.

# DEDICATION

To Sara, Diana and our baby girl who is to come.
It is my hope that my work on this thesis will eventually make our world a bit closer to becoming what I wish it already was for all of you.

To Ana Maria, Constanza and Luna, and all the women in my family, whose work on education and equality inspired me to pursue this topic.

To Tirso, my father, who taught me to be the student I want to have when I am teaching, and the teacher I want to have when I am studying.

# CHAPTER ONE

## Introduction

In 2015, the new National Education law in Chile was signed by President Michelle Bachelet with far-reaching implications for tertiary institutions, beginning in 2016. In the international scenario, Chile is usually portrayed as a developed country, the first in South America to become a member of the Organization for Cooperation and Economic Development (OCED) and having one of the highest Per Capita Income levels in the region. However, Chilean society is also riddled with high levels of socioeconomic segregation, as reflected by its GINI Index, which ranks it as one of the most unequal nations in Latin America, and also by the rampant socioeconomic segregation in its educational system. This segregation can begin as early as pre-school and its repercussions are most noticeable in the type of high school that families can afford to send their children and their transition to higher education. As research has shown, students who attend public municipal high schools represent more than half of all secondary enrollment, but less than a third of all university students.

For income to not continue being a prohibiting barrier in access and retention within higher education, one of the main changes of the 2015 Education Law that was passed by Congress and the Senate was a government-sponsored full tuition and fees subsidy for students who belong to the 50% lowest income households in the country. Nothing similar to this benefit had been available for Chilean college students since the decade of 1970. In recent decades, students could only apply for different forms of

student loans and credits. Furthermore, the 2015 full-funding benefit was extended to anyone who was entering or continuing their higher education studies in 2016. Funding in education had been a point of contention for decades in Chile, especially as one of the focal points in the 2006 "Penguin Revolution" and the 2011 college student protests, two social movements led by young students who demanded that the Chilean Government devote a larger portion of its budget to improved access and quality of education across all levels.

The manifest intent of the education law was to have an impact on income inequality in access and retention to colleges and universities, which is the first outcome that the thesis explores, using as proxy the type of high school that university students come from and their distribution within Undergraduate Degree Programs (UDP), which serve as the main unit of analysis for the study. However, there is a second theoretically-driven outcome studied, focusing on the effects that the 2015 Education Law had on gender disparities, which was not an intentional goal of the legislation, but from an intersectional approach, one should expect for gender to be related to social class and income inequality.

Access to colleges and universities is somewhat different in Chile than in the United States, as offers of admission to undergraduate programs rely exclusively on standardized testing, high school Grade Point Average and individual ranking within the applicant's cohort. Placements in each program are defined before the admissions process and, thus, candidates are competing among each other to have the best standardized scores within those placements, or at least having a top position in the waiting list. From a methodological standpoint, however, these differences ensure that admissions

committees, subjective evaluations, recommendation letters, and extracurricular activities are not playing a confounding role in the analyses.

As research on the relation of gender inequality and education has established over the past three decades, studying gendered disparities by observing macrostructural aspects, such as the total number of females to males enrolled at colleges, can obscure the inequalities that occur within academic fields and institutions (Jacobs, 1996). Research has found that female enrollment in STEM majors, for example, has not increased at the same rate than overall female access to tertiary education. This, in turn, can have a negative effect on public policies geared towards promoting equality, since the general public may be inclined to believe that the battles against gender disparities in education have been won, hiding some of the more subtle aspects in the complex relation between gender and equitable access to education. This study focuses particularly on Chilean universities, one of the three types of higher education institutions in the country, and sheds light on the interaction between higher education quality, gender and social class and how they can change based on providing full scholarships for low-income students.

This thesis aims at inquiring deeper into the effects of the 2015 law had for both class and gender disparities by examining changes in the percentage of students from public high schools and in the ratio of females to males in undergraduate degree programs, while focusing on other relevant aspects, such as academic fields, which can be an important predictor of workforce participation and future earnings. The dataset used was governmental information on every undergraduate degree program imparted at Chilean Universities, which included total enrollment by type of high school and by gender, while also including gender data for first-year incoming cohorts. In Sociology of

Education, a large portion of the work on gender inequalities have been provided by international studies and comparisons of countries such as Israel, Germany, Russia, and Turkey, as well as the USA. By focusing on gender parity in first-year enrollment, this thesis expects to bridge that gap and provide empirical evidence to support the critical and intersectional perspectives claiming that there is a close relation between class, gender and access to higher education.

In the following chapter, corresponding to the Literature Review, the first section expands on the key aspects that make Chilean society as a whole and its higher education system a proper case to study for the relation between income and gender disparities. Also, the sociological frameworks to research class and gender inequality in it are explored, considering both seminal and current studies from the past three decades, which have laid the conceptual and theoretical foundations for this thesis, followed by the hypotheses. The following chapter describes the OLS regression methods used, as well as the results obtained for each hypothesis, using Undergraduate Degree Programs (UDP) taught at a Chilean university between 2012 and 2019 as the units of analysis. The main dependent variables were the proportion of students from public high schools and the ratio between females and males. The independent variables were the institutional-level condition of a university participating in the scholarship initiative, which are considered to be higher quality than those that were not, and whether the 2015 law has had a statistically significant moderating effect for the class and gender disparities observed within UDPs at top-tier universities before 2016, the first year that the law was applied. Lastly, the discussion of the results and the conclusions of the study are the final chapter of the thesis, followed by the appendices and the list of references.

# CHAPTER TWO

# Literature Review

## *Higher Education in Chile*

The need for deeper inequality studies in Chilean society stems from aspects like the fact that Chile is constantly recognized as one of the most economically and technologically developed countries in Latin America, projecting an image of well-being for international audiences (Guzmán-Concha, 2017). However, it is also one of the most unequal, as evidenced by the GINI coefficient and the impact of higher education costs on household income (Lopez & Miller, 2008; Palma, 2008; Castillo, 2011). As De Gayardon and Bernasconi (2016) describe, Chile's higher education was greatly affected by the dictatorship of General Pinochet from 1973 to 1990, by expanding it and also introducing tuition fees for anyone who would decide to enroll, eliminating the sliding cost system that was in place before. Prior to the 2015 Chilean Education Law (CEL), Chile was the OECD country with the smallest share of public expenditure in higher education and, when adjusted to per capita gross national product, the second with the highest level of tuition fees after the United States (De Gayardon & Bernasconi, 2016; Chiroleu & Marquina, 2017).

In this context, research shows that publicly funded high schools take the largest share of students in general, but they also contain most lower income students, which severely decreases their representation in higher education. Given this reality, and the daunting costs of university education, it is likely that some, perhaps many, low-income high-achieving high school students elect not to apply to universities. Those limited

positions may then go to charter and private high school students even if their scores are lower, but who are less affected by public policies and financial aid (Bell, 2009; Attewel et al., 2001; Santelices, Horn, Catalan, 2018). In this way Chile can simultaneously exhibit high quality education while also limiting the opportunities of many who might otherwise would qualify for access to that education were the costs not so prohibitive.

Table 1 shows how high school enrollment has been distributed in Chile from 2004 to 2018 for the three main types of high schools. In the beginning of this period, public school students represented a higher percentage than those at charter schools. In 2018, however, students from public high schools are only 35.36% of the total and those at charter schools are more than half in the entire country. Furthermore, private high school students have nor surpassed 10% of the total high school enrollment in Chile.

Table 1.

*High school students in Chile per type of school from 2004-2018*

| | Enrollment | | | Yearly Percentage | | | |
|---|---|---|---|---|---|---|---|
| Year | Public | Charter | Private | Public | Charter | Private | Total |
| 2004 | 450477 | 404369 | 80117 | 45.67% | 41.00% | 8.12% | 986302 |
| 2005 | 461706 | 432782 | 74867 | 45.01% | 42.19% | 7.30% | 1025710 |
| 2006 | 453352 | 456269 | 73656 | 43.62% | 43.90% | 7.09% | 1039437 |
| 2007 | 440051 | 460153 | 74203 | 42.73% | 44.68% | 7.20% | 1029890 |
| 2008 | 422070 | 464516 | 74033 | 41.56% | 45.74% | 7.29% | 1015458 |
| 2009 | 410916 | 467704 | 73220 | 40.85% | 46.50% | 7.28% | 1005815 |
| 2010 | 392421 | 471979 | 73377 | 39.57% | 47.59% | 7.40% | 991716 |
| 2011 | 376632 | 476189 | 73944 | 38.43% | 48.59% | 7.55% | 979987 |
| 2012 | 34563 | 471255 | 72835 | 3.68% | 50.19% | 7.76% | 938936 |
| 2013 | 335769 | 467375 | 73682 | 36.30% | 50.53% | 7.97% | 924905 |
| 2014 | 327195 | 462045 | 73915 | 35.97% | 50.79% | 8.13% | 909674 |
| 2015 | 324936 | 460066 | 74649 | 35.89% | 50.82% | 8.25% | 905244 |
| 2016 | 318824 | 456865 | 76633 | 35.50% | 50.87% | 8.53% | 898171 |
| 2017 | 317040 | 456124 | 78090 | 35.36% | 50.88% | 8.71% | 896547 |
| 2018 | 305049 | 449352 | 85632 | 34.02% | 50.11% | 9.55% | 896755 |

Source: Chile Secretary of Education, 2019.

Chile's Higher Education, unlike in the United States, is closer to the professional formation model of European institutions (Ceron, Van de Werfhorst & Bol, 2020). Students who have finished high school will enter a specific program that will grant them a professional degree, which will greatly define the specific jobs that they will be able to apply for once they have completed their degree. Universities in Chile typically grant 5-year degrees that include academic diplomas that allow for graduates to continue onto master's or doctoral studies. Hence, postgraduate education tends to serve more as a form of specialization than a professionalization (Zelaya 2015). Thus, gaining access to university education in Chile is a significant first step towards eventually entering the job market, as undergraduate degrees include competencies and skills that individuals will use after entering the job market (Rodríguez, Urzua, & Reyes, 2016).

Furthermore, Chilean undergraduate programs have a stricter curriculum for their students to follow and each degree granting program has a stable number of admission placements for incoming students. For example, if an undergraduate student was in their second year of an engineering major and then decided that they would prefer to become a lawyer, liberal arts education in the United States would allow them to change their major and the requirements they would have to meet in order to qualify for Law School would be minimal. In Chile, on the other hand, Law is an undergraduate degree with a strict professional curriculum, thus requiring for such student to default on all of their engineering classes so far and to take a new college entrance exam to meet all standardized requirements for the Law program. This example illustrates the rigidness of the system, which can be an advantage for students who have a clear career path that they want to follow, but a barrier to those who would wish to explore different fields.

Furthermore, the fact that moving from one degree to another is seldom allowed and almost never encouraged, means that researcher can accurately predict the professional placements of students based on the academic affiliation of their programs. STEM students would rarely qualify for a job in the Humanities, and vice versa.

Since returning to democracy in 1990, the Chilean government has taken mostly a subsidiary role with fundamental national resources, such as energy, water, and highways, to name a few, which has led to an increased cost of living and high levels of personal and household indebtednesss (De Gayardon and Bernasconi, 2016; Gregorutti, Espinoza, Gonzales & Loyola, 2014). Higher education has not been an exception to this trend, with a fragmented system of public universities receiving decreasing support from the central government, while a large number of private universities have been created with questionable standards of quality and some of which have been subsequently accused of illegally profiting from their activities (Santelices, Horn & Catalan, 2016; 2017; Ceron, Van de Werfhorst & Bol, 2020). The 2015 law distinguished between universities that can participate in the funding initiative and those who cannot, based mostly on quality and equal-access criteria.

Another argument that underlines the relevance of studying access and selection in higher education in Chile, is the fact that undergraduate programs in Chile do not consider subjective factors, such as letters of recommendation, submitted essays, or extracurricular activities (Von Hippel & Hofflinger, 2020; Ceron, Van de Werfhorst & Bol, 2020). The entrance system in Chile is based on a standardized test, which is similar to the SAT but can be taken once a year only, as well as on overall high school GPA and

individual ranking. Thus, subjective assessments by entrance committees do not play a confounding role, as they could in a system like the United States.

Prior to the 2015 education reform, one of the main changes that occurred in higher education was the implementation of an accreditation system that has undergone a number of adjustments during the last decade, but that has increased the attention that university and college leadership places on quality (Jerez & Blanco, 2018; Jerez, Orsini, Hasbun, Lobos & Muñoz, 2018). While a number of aspects can and must be improved, according to numerous authors, there is more or less of a consensus on the importance that a national accreditation system entails for families and students to know the characteristics of the institutions that they will be entering (Zapata & Tejeda, 2018; Busco, Dooner & D'Alencon; 2018). As Mizala and Schneider (2019) underline, accreditation processes occur independently at the institutional and at the undergraduate program level. Furthermore, accreditation is a more reliable indicator than reputation, as it was before this system was implemented, since it considers at previous achievements as well as changes occurred to increase student professional competencies, as well as retention and graduation rates (Mizala & Schneider, 2019).

The 2015 education reform in Chile aimed at changing income inequality in higher education by covering full tuition and registration costs for new or current students who come from the 50% lowest income households in the country (De Gayardon & Bernasconi, 2017). However, this funding initiative does not cover all higher education institutions. In order for a university to participate, they must meet various specific criteria, such as being accredited for at least 4 years, which is interpreted as meeting higher quality indicators than those accredited for 1 to 3 years, as well as agreeing to

adopt the new entrance system for higher education, and ensuring that, for at least a year, they have had equal access policies in place (Zelaya, 2015; Bernasconi & Celis, 2017). Thus, one could argue that institutions that are included in the program represent more equalitarian university models, but also higher quality, which has been one of the central demands of student social movements over the past 13 years. Finally, for a UDP to be eligible within selected institutions, they must be regular undergraduate programs, as the funding does not apply for graduate or special programs. Also, they must be taught fully face-to-face, because virtual or semi-virtual programs are not included in the 2015 law (Chiroley & Marquina, 2017; Guzmán-Concha, 2017).

Research has, thus, either focused more on individual characteristics and outcomes (Webb, 2018; Venegas-Muggli, Muñoz-Gajardo & González-Clares, 2019) including aspects such as persistence and resilience, or in aggregate level perspectives (Santelices, Horn & Catalan, 2016; 2017). In the aggregate or institutional perspective, some of the aspects that have been considered are the management of the institutions, whether they belong to the State, to traditional corporations created before 1981, or non-traditional corporations created after (Salazar & Leihy, 2017).This thesis can contribute to the current body of knowledge of Chilean Higher Education by considering Undergraduate Degree Programs as its unit of analysis and focusing on an intermediate level analysis of social inequality.

*Frameworks for Social and Gender Disparities in Higher Education*

Several sociology studies over recent decades have focused on social inequality in education in general and, particularly, on social and gender disparities in higher education. A number of these have used international comparisons in order to demonstrate that access to higher education is tied to material and cultural resources across different societies. Chile, thus, offers a particular case to study how changing the material conditions may affect both social and cultural patterns about class and gender composition of higher education.

Much of research about higher education and socioeconomic status has focused on macroeconomic changes and the effects of limited policies aimed at financial aid and student loans (Solis, 2017; Zhang et al., 2013). In Latin America, the study of social gaps among has either been undertaken in contexts with long-term government-sponsored tuition waivers and cost-reduction programs, or it has explored changes with limited social change capabilities, either based on credit-based systems or the granting of small financial benefits, such as enrollments fees waivers (Rossetii, 2014; Bernasconi & Celis, 2017; Chiroleu & Marquina, 2017). Authors tend to agree that while one cannot account for all cultural differences between Latin America and developed countries like United States and Europe, there are still aspects worth analyzing in depth in these developing societies that may bridge some of the gaps in knowledge for academia.

Whether it is in China, South Africa, or Germany, research has found that students coming from the lowest income households are continuously underrepresented in elite colleges and universities, regardless of financial aid and merits that they may display (Sewell, 1971; Sylwester, 2000; Buchmann, DiPrete & McDaniel, 2008; Duman,

2008; Metcalf, 2010). On one hand, research has found that policies that aim at economic liberalism can cause worsen social inequities, as they tend to increase the reliance on private and household resources for access to higher education. While other authors, such as Pallais and Turner (2007), argue that general policies can be inadequate for specifici institutional needs, there is consensus on the fact that in the 21st century economies all over the world, higher education is closely related with quality of living and improvement of conditions towards the future. The more significant the role of social and economic status in accessing higher education, the more notorious the gaps and inequalities will be in the long term (Davies & Guppy, 1997; Azzoni & Servo, 2002; Blanden & Machin, 2004).

Pallais and Turner (2007) analyzed the use of institutional financial aid programs, concluding that the cost of each institution implementing their own initiative can make access for low-income students depend on institutional characteristics, but also pointing out that there should not be a one-size-fits-all policy, since this would play against universities individual characteristics and strengths. They mention also that due to the differences in preparation during high school years for lower and higher income students, the largest challenges posed by the results in standardized tests will continue to be persistent and sizable. The Chilean experience can provide support for some of these arguments, since its system allows for a fairly unique case on the recent changes and effects of granting full tuition subsidies for low-income students and how the intersections between class and gender in access to varying levels of quality and academic field in higher education with full coverage of undergraduate degree programs imparted at Chilean universities over the last eight years, spanning from 2012 to 2019.

Focusing on spending and public policies, Carnoy (2011) analyzed common features of higher education expansions in developing countries, including China, Russia, Brazil and India. He suggests that three unusual variables that play a big role in how these expansions have contributed to greater inequality, are a decrease in public spending between higher and lower levels of education, increased spending differences between elite and mass universities, and rising returns to university education relative to secondary and primary education. He points out to the fact that in 2008, Latin American countries including Argentina, Brazil, Chile and Mexico, all lagged behind the redistributive impact of taxes and transfers when compared to European nations. Conssitent with other critical analyses, Carnoy argues that expanding higher education with differentiated levels of quality will actually worsen social inequality when comparing those who attend lower cost and quality institutions to those who attend first-tier public or private elite universities. Similar findings by van der Berg (2007), Azzoni and Servo (2002), and Blanden and Machin (2004), have pointed to how expanding university systems without ensuring quality and equity can mainly benefit higher income students.

One of the seminal works in Sociology on Gender Inequality in Higher Education is Jacobs (1996) whose contributions to this study include mentioning the importance of considering class and gender inequality simultaneously as a central focus. In his view, classic studies of inequality in education had either focused only on men (Blau & Duncan 1967, Bourdieu & Passeron 1977, Collins 1979, Karabel & Halsey 1977) or had dedicated only minor attention to women. To answer some of Jacobs concerns, the following section focuses on Intersectionality and Gendered access to Universities, but

for this section, I will examine some of his work on traditional perspectives on gender inequality that have populated social sciences and sociology. Jacobs refers to access as the first of three stages of higher education for women and observes that an improvement of female gender participation at the macro level of statistical analyses has not been replicated throughout all tertiary education isntitutions. As he found in his analyses during the 1990s, gender segregation at top-tier universities persisted, implying that females who have entered higher education will continue to obtain lower-paying jobs than males, due to the factors such as reputation and social capital.

Another question that the literature points towards, aside from overall enrollment and social class, is the field in which higher education students enroll in. This is particularly relevant for the Chilean context, where switching fields can come at a great financial and personal cost. Relevant authors in this field such as Jacobs (1996, 1999), Charles and Bradley (2002), and Bobbit-Zeher (2007), have focused on gender segregation in the field of STEM. Consensus seems to indicate that while women have improved in access and completion of higher education, even at greater effectiveness than males in some countries over recent decades, there still seems to be a clear segregation in STEM fields. Barone (2011) and other authors working in the same line, elaborate on the importance of considering horizontal and not just vertical forms of gender segregation, A vertical perspective would focus on whether access to tertiary education has improved for all or just some secondary students. Horizontal segregation, on the other hand, refers to the phenomenon on how disparities occur at the interior of educational levels, institutions, and even within academic fields. Barone suggests that controlling for

gendered stereotypes, such as the care-technical divide, can improve explanations of horizontal segregation at deeper levels than the usual STEM-humanities distinction.

Gendered access to STEM fields has been analyzed also from social and cultural reproduction perspectives, alluding to the lack of role models to follow for females and social minorities. In the United States, for example, Bradley et al. (2009) analyzed female STEM faculty members at universities, particularly those who work at historical black colleges, finding that females at these institutions can be a minority among minorities, since African, Indian, Asian and European faculty members can outweigh them. Teller, Backstrom & Bjorklund (2017) argue that social belongingness, referring to the expectation of how well one will fit socially, can play a pivotal role in how younger generations choose the fields of their future careers. In order to continue decreasing gender inequalities in higher education, they argue that more and deeper research is necessary, as their study of social belongingness in Sweden was one of the first to explore this variable as cause for horizontal gender segregation in field of study. All of these literature sources have found that gender inequality is present across the world and that its effects and causes have complex relations that require researchers to look deeper than just sheer measures of access and opportunity for women.

One of the tools that is used internationally to measure gender inequality in education is the Gender Parity Index. As research has shown (Shannon et al., 2013; Akbash, Pasichnyk & Rizhniak, 2019; Odaga, 2020) this measure popularized by UNESCO in 1999 can serve as a useful tool for analyzing equality of opportunity in access and retention in education, by dividing the total number of females by the total number of males enrolled. Especially in international studies on education, the Gender

Parity Index (GPI) has mostly been used to study gender inequality at the national, regional, local, and institutional level (Huq & Rahman, 2008; Wiseman, 2008; Shannon et al., 2013; Vaca et al., 2014; Akbash, Pasichnyk & Rizhniak, 2019; Odaga, 2020). Currenly, United Nations publishes the index information and Chile is recognized as one of the countries with the best GPI of Latin America.

While much of research on gender inequalities around the world has focused on empirical results and relations, there are also a number of works that contribute to the theoretical and conceptual perspectives with which one can set research hypotheses for gender inequality. Findings suggest that female enrollment increases when Western countries reach certain levels of economic stability, development and well-being, even surpassing overall male enrollment from a macro-perspective. However, research on female enrollment also calls for attention to be placed on the type and quality of institutions where female enrollment tends to concentrate, as well as the academic fields in which this occurs.

The notion that gender disparities could be decreased by a Law that did not aim directly at it, was based on critical and intersectional positions on higher education that focus on inequality and how they are interrelated. According to Lutz (2015) intersectional research initiatives are currently an object of contention among scholars who have their individual views as to what the goals and paths to reach them should be. One of the aspects she criticizes is the fact that most researchers seem to have a specific demographic "master" variable from which other inequalities stem.

Amartya Sen (2001) explains the layered reality of gender inequality by stating that even though there may be little differences in schooling, research has found that

opportunities in higher education, employment and promotions can be harder to obtain for young women than for young men. Even though Chile has been recognized internationally as a developed country, it is feasible to expect gender inequality to exist, given that Sen observes that gender biases in higher education and professional training can be found in any of the rich countries of North America and Europe. Furthermore, while the existence provinces specific for men and women are rarer now, gender asymmetry continues to exist in many areas of education and training all across the world. In Europe, works by Ferrant (2015), Friedhoff, Werner, and Roman (2019), as well as Ronsijn (2014), have discovered that even in developed countries, patriarchal cultural norms put women in a secondary position when it comes to access to higher education and participation in academia.

As Winker and Degele (2011) argue, intersectionality requires a multi-level analysis that considers reciprocal effects between the various levels. Regarding the construct of merit-based economies, for example, Castilla (2012) shows that gender and racial differences affect performance evaluations, salaries and career setting stages, even after merit-based methods have been implemented, thus affecting the financial and professional outcomes of women and racial minorities. Johansson and Sliwa (2013) found that internationalization of higher education can project an image of integration and inclusion, but that the narratives of women indicate that the merit-based system and competition can isolate individuals belonging to minority groups.

## *Hypotheses*

Based on the literature review, the hypotheses for the thesis are presented in the following section. Hypotheses related to the type of high school that university students attended are presented first, followed by the hypotheses focused on gender.

### *Hypotheses Related to Enrollment from Public High Schools*

*H1a* – If the 2015 Chilean Education Law had a positive effect on class inequalities, then undergraduate programs at Universities where the funding is available will see a positive significant increase in enrollment by students from public high schools, net of cohorts size, academic field, gender parity in previous cohorts, and other control variables.

*H1b* – If the 2015 Chilean Education law had an equalizing horizontal effect, then undergraduate degree programs across all academic fields will see an increase of students from public high schools, net of other independent and control variables.

*H1c* – If social class is intersected with gender within undergraduate degree programs, then gender parity in previous cohorts will have a positive effect on the number of students from public high schools at universities in which the funding is available, net of other independent and control variables.

### *Hypotheses Related to Enrollment from Charter and Private High Schools*

*H2a* – If the 2015 CEL improved access and retention for low income students, given that undergraduate degree programs have limited spots in their cohorts, then the number of students from charter and private high schools will decrease at Universities where funding is available, net of other independent and control variables

*Hypotheses Related to Gender Parity in Overall Enrollment*

*H3a* – The interaction between the implementation of the 2015 CEL and Universities that have participated funding will have a positive effect on total female enrollment in undergraduate degree programs that are eligible (unsupported)

*H3b* – The interaction between the implementation of the 2015 CEL and Universities that have participated funding will have a positive effect on total female enrollment in undergraduate degree programs across all academic fields (unsupported)

*Hypotheses Related to Gender Parity in First-Year Enrollment*

*H4a* – If the Chilean 2015 Education Law had a positive effect on gender parities in incoming cohorts, then the interaction between the application of the 2015 CEL and Universities where the funding is available will have a positive effect on Gender Parity within undergraduate degree programs, net of other independent and control variables.

*H4b* – If the Chilean 2015 Education law had a horizontal effect on gender disparities, then undergraduate degree programs across all academic fields at Universities where the funding has been available will have a positive effect on Gender Parity within STEM undergraduate degree programs, net of other independent and control variables.

# CHAPTER THREE

## Data, Method, and Results

### *Data and Method*

The National Information System for Higher Education (SIES in Spanish) is a dataset published by the National Government which includes indicators for every Higher Education program taught in Chile since 2007. The research goals for this thesis were to examine the effects of the Chilean Education Law of 2015 on its manifest intention, which was to decrease socioeconomic segregation in access and retention within higher education programs. Thus, it required a dataset that had information for every undergraduate degree program, as well as the distributions for type of high school, as a proxy for class, and for gender within its student body. In order to analyze enrollment at higher prestige academic fields, SIES was the only dataset available that allowed for a classification of STEM and non-STEM programs based on international standards set by the Organization for Economic Cooperation and Development. Having this data available, the second research goal was theoretically driven, as according to intersectional approaches, one could expect an improvement for female enrollment when income inequality decreases.

Data contained in the dataset covers the program's academic field, the institution's identification, the year the program was taught, as well as data on the total number of students enrolled and the first year incoming students for each program, both with the distribution by gender, covering 100% of the total student body. However, SIES does not

have information on the type of high school for first-year students and its coverage only adds up to about 90% of the student body. One of the main limitations of the dataset is the fact that it does not contain a large number of relevant variables for using as controls in the analysis. Thus, this study is set up as an initial step in a long-term project where empirical evidence about the effects of funding in higher education on social inequalities can be presented.

As it has been described so far, the data used in the study has the undergraduate programs as unit of analysis. Undergraduate programs have a pre-defined number of vacancies for first year enrollment, which means that an increase in one group can be inferred as associated with a decrease in another group. The thesis findings support this for the type of high school that students graduated from.

For an accurate study of the effects of the 2015 Education Law in Chile, only programs where students would have been eligible to receive the benefit are considered as part of the sample. They must be regular undergraduate programs, as the funding does not apply for graduate or special programs. Also, they must be taught fully face-to-face, as the 2015 CEL excluded virtual or semi-virtual programs. The SIES only began to record these characteristics in 2011, but to ensure that there is an equal number of years before and after the application of the 2015 education law, the analysis was applied to undergraduate programs in the years between 2012 and 2019.

### *Dependent Variables*

The outcome variables used in the study were related to student-body composition, as proxies for access and retention of students in higher education. They refer to the distribution of enrollment by type of high school and by gender in each

undergraduate program taught at Chilean Universities over the past eight years. Due to the skewness identified throughout the initial descriptive analysis, the regressions were performed using natural logarithms and inverse hyperbolic sine transformations where it corresponded, so the normality assumption would not be violated.

For the type of high school that students graduated from, the variables used in the regressions were the raw number of students from each of the three major types of high schools among the total reported. Thus, the analyses used three dependent variables, one for each type of institution, namely public, charter and private. Public high schools are managed by municipal corporations and charge no mandatory fees to parents or tutors. Charter high schools belong to private non-profit corporations and charge monthly fees to each student attending, meaning that parents must be able to afford tuition and enrollment fees, while also receiving a standard financial support from the government for each student. Private high schools are managed by private non-profit entities and receive no support from the government, thus representing a higher cost to the parents and tutors. The SIES reports the type of high school for approximately 90% of the students enrolled in each program, which prevented the use of percentual distributions or proportions. As mentioned above, these three dependent variables had to be transformed, due to their skewness. Since many undergraduate programs had values of zero the transformation used here was hyperbolic sine transformations.

To measure gender parity there are two separate expressions that were used, given that SIES reports the full distribution by gender for the entire student body enrolled in an undergraduate degree program, as well as for the incoming cohort of first-year students. It is important to keep in mind that the benefits granted by the 2015 Chilean Education

Law were applicable to qualifying students that were enrolled at the time or were enrolling for the first time in a higher education program. Thus, it is logical to expect that the law would affect separately both types of enrollment.

The Gender Parity Index (GPI) was calculated by dividing females by males in each undergraduate program for the entirety of the student body, named Total GPI for the remainder of the thesis, and it was also calculated for each year's incoming cohorts, which is named First-year GPI. These two dependent variables on gender parity offer a relevant and nuanced facet of the analysis, since total enrollment can change due to both positive and negative outcomes, such as graduation and incompletion, respectively.

While Gender Parity among first-year students is closer to serving as a proxy for equality in access to higher education, Gender Parity within the full student body has an added component of retention and continuing higher education processes. It is also important to separate the analysis for these two dependent variables, as it is done at the end of this chapter, due to the fact that individuals who make up first-year enrollment are replaced on a yearly basis, meaning that First-year GPI can show responses to other stimuli at a much faster pace than Total GPI.

To address the suitability of using the Gender Parity Index, Appendix A presents a table where one can see that for the variables in our full model, the coefficients for GPI highly resemble the difference between Female and Male enrollment up to the third decimal or more. The advantage of using GPI is that one can represent the ratio of females divided by males in one numerical expression and the size of the cohort does not confound the results, allowing the researcher to use it as an independent variable.

*Independent Variables*

The main independent variables in the study were the period in which the annual enrollment for the undergraduate program was registered, based on the application of the 2015 law, and the other was whether the university has been a participant at some point in the funding program. Participation in the funding program was the proxy in this study for operationalizing the distinction between top-tier and lower-tier Universities, since they must meet specific criterion, the main of which is to be accredited for at least 4 years, having met higher quality indicators than those accredited for 1 to 3 years. The Chilean accreditation system allows for accreditations to be valid from 1 to 5 years. Almost all qualifying universities have participated in the funding program throughout its entire duration. SIES did not include this information in the dataset, so it had to be manually entered, based on official documents from the Secretary of Education that were accessed through the Chilean equal to a Freedom of Information request. Because the Chilean accreditation process analyzes an institution's recent history and future projections, this variable was coded as 1 for Universities that have participated at any point in the funding initiative and labeled as "Participating Universities", and 0 for Universities that have not participated at any point in the funding initiative and labeled as "Non-participating Universities".

Another independent variable is whether the undergraduate degree program is in STEM or not, since the SIES contains the internationally valid OECD classification with its categories and subcategories, allowing to distinguish Science, Technology, Engineering and Mathematics from the other academic fields such as Humanities, Business, Social Sciences, and Health, to name a few. Hence, for this variable, programs

in Science, Technology, Engineering and Mathematics were coded with a 1, while other undergraduate programs were coded with a 0 and labeled as “Non-STEM” programs.

The remaining independent variables in the study are the size of the student cohorts enrolled in the programs, which the previous research said could have a relevant impact on the likelihood of students entering higher education. The regression analysis controls for both student body size variables as it was necessary to have them present in all models, in order to avoid the institutional differences in sizes for first year and for previous cohorts having a confounding effect on the results. For example, in the eight years under study, from 2012 to 2019, there was an increase in first-year cohort size of approximately 10%, as first-year cohorts at non-participating universities grew from 38.6 students to 42.0, and from 52.5 to 57.1 students at participating universities. As with other variables in the study, due to skewness, I employed the natural logarithm, in order to maintain as many cases in the sample as possible, although this meant excluding those that had a value of zero. While it would have been advisable to use the inverse hyperbolic sine, natural logarithm transformation effectively reduced skewness and allowed for an even analysis of undergraduate programs with at least one female and at least one male in most of the regressions.

Tables with the VIF results are attached in Appendix B for each of the dependent variables used in the study, in order to show that none of them surpass a value of 2, which is considered ideal for OLS regression. Only the interaction surpasses this level of VIF, but as can be seen in Appendix B, even when considering the interaction for the VIF the value obtained is under 3.1.

### *Control Variables*

The control variables in the study are mostly administrative characteristics of each undergraduate program that were available in the SIES dataset. They refer to the administration of universities, whether they belong to the State (coded 1) or to private corporations (coded 0). The second control variable was whether the program is taught at the Chilean capital (coded 1) or in the other regions of the country (coded 0). As mentioned in the Literature review, Chile is a highly centralized country and its capital, Santiago, concentrates almost half of the entire Chilean population.

The third control variable used in the regression analysis was the time of day in which the classes of the undergraduate program are taught, since students with higher levels of responsibility outside of their studies are more likely to choose attending night classes. Thus, programs with classes taught at night were coded 1 and those with daytime classes were coded 0. The fourth control variable found in the dataset refers to the number of semesters to completion. The relevance for this variable relies on the fact that, according to the Literature, students with financial needs will be more likely to choose undergraduate degree programs that will have a lower number of semesters required in order to obtain a professional degree.

### *Sample*

The full sample describes all undergraduate programs that had the characteristics that made them eligible for their students to receive the benefits from the funding initiative, before listwise deletion used used in the regression analysis. To ensure in the analysis that the results were not due to outliers or extreme cases, Stata's tools were used

to run the models using dfits, r-studentized, and dfbeta to exclude influential cases and outliers. Results obtained after excluding extreme cases were similar to the full sample.

In Table 2, for the dependent variables, one can see that the maximum for female first year enrollment was 312 and for male first year enrollment it was 632. Among the independent variables one can see that in the maximum for non-first year females was 1,515 and males was 3,507.

As the dataset used is institutional information covering the entirety of enrollment in Chilean Higher Education from 2007 to 2019, the sample analyzed did not have many missing cases. Of the 22,712 undergraduate programs that have the characteristics that make them eligible for their students to be benefitted by the funding initiative, 550 did not have any males enrolled, which made it impossible to calculate the Gender Parity Index. Nonetheless, working with institutional data represents one of the limitations of the study, in terms of the dataset not containing any more variables that could be used for control without increasing multicollinearity. As it is described in the projections of the study, this issue could be solved in future research initiatives by requesting more robust datasets through official channels from the Chilean government. As it stands at the time, among the available datasets on higher education, SIES was the only one that allowed to complete the analysis required to answer the study's research questions.

Table 2.

*Descriptive Statistics for the full sample of eligible programs*

| Variable | Obs | Mean (%) | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Enrollment | 22712 | 199.10 | 224.5905 | 2 | 4873 |
| Students from Public High Schools | 22712 | 48.49 | 49.40248 | 0 | 824 |
| Students from Subsidized High Schools | 22712 | 98.77 | 101.4433 | 0 | 1001 |
| Students from Private High Schools | 22712 | 35.36 | 125.7262 | 0 | 3560 |
| Female Total Enrollment | 22712 | 105.77 | 124.2988 | 0 | 1515 |
| Male Total Enrollment | 22712 | 93.33 | 135.5077 | 1 | 3507 |
| Gender Parity Index for Total Enrollment | 22712 | 2.85 | 9.414094 | 0 | 320 |
| Total First Year Enrollment | 22712 | 47.60 | 48.04818 | 1 | 851 |
| Female First Year Enrollment | 22712 | 24.76 | 26.79978 | 0 | 312 |
| Male First Year Enrollment | 22712 | 22.84 | 29.8802 | 0 | 632 |
| Gender Parity Index for First Year | 22162 | 2.38 | 5.043309 | 0 | 110 |
| Total Previous Cohorts Enrollment | 22712 | 151.50 | 183.3184 | 1 | 4092 |
| Female Previous Enrollment | 22712 | 81.01 | 101.0997 | 0 | 1203 |
| Male Previous Enrollment | 22712 | 70.48 | 109.5929 | 1 | 2993 |
| Gender Parity Index for Prior Enrollment | 22712 | 2.93 | 8.931357 | 0 | 245 |
| Participating Universities | 22712 | 0.50 | | 0 | 1 |
| Non-participating Universities | 22712 | 0.50 | | 0 | 1 |
| 2012-2015 Period | 22712 | 0.48 | | 0 | 1 |
| 2016-2019 Period | 22712 | 0.52 | | 0 | 1 |
| STEM Fields | 22712 | 0.28 | | 0 | 1 |
| Non-STEM Fields | 22712 | 0.72 | | 0 | 1 |
| State University | 22712 | 0.26 | | 0 | 1 |
| Non-State University | 22712 | 0.74 | | 0 | 1 |
| Capital | 22712 | 0.38 | | 0 | 1 |
| Oher Regions | 22712 | 0.62 | | 0 | |
| Night Classes | 22712 | 0.19 | | 0 | 1 |
| Daytime Classes | 22712 | 0.81 | | 0 | 1 |
| Semesters to Completion | 22712 | 9.15 | 2.182835 | 2 | 24 |

### *Interpretation of Results*

Due to the use of natural log and inverse hyperbolic sine transformations to reduce skewness within all dependent and some independent variables, it has become necessary to clarify that coefficients cannot be substantively interpreted directly as they appear on the table. Hence, their effects must be calculated according to whether they represent a log-linear or a log-log relation.

For those coefficients where the dependent variable is transformed, but the independent is not, the value presented in the coefficient must be interpreted after using the following equation:

= (EXP (Bx)) – 1

Thus, a statistically significant coefficient of 0.057 for a dummy variable, such as the effect of an undergraduate program being in STEM on the number of students from public high schools who are enrolled in it, will be interpreted as undergraduate programs in STEM being associated with a 5.87% increase in the number of students from public high schools.

For those coefficients where both the dependent variable and the independent variable is transformed, the value presented in the coefficient must be put in an equation that accounts for a specific value increase in the independent variable. If we were to choose a 10% increase, for example, then the formula would read as:

= ( 1.1 ^ Bx ) – 1

Hence, we would interpret a coefficient of 0.251 as implying that a 10% increase in the independent variable is associated with a 2.42% increase in the dependent variable.

## *Results*

In the Results section, the content is organized according to the four sets of hypotheses that were presented at the end of the Literature Review in Chapter 2. The first two subsections refer to the results related to the type of high school that university students come from in the programs and periods under study. The following two subsections focus on the results for gender parity within the entire student body and within first-year cohorts.

*Analysis by Type of High School*

As it has been mentioned before, this thesis focuses on Undergraduate Degree Programs and uses OLS regression analysis. However, this initial sub-section in the analysis presents an overall picture of social inequality in Chilean Higher Education, based on the distribution of enrollment by the type of high school that current university students graduated from. The tables that support these figures included in it can be found in Appendix C for the overall enrollment and in Appendix D for enrollment in STEM programs.

Figure 1 shows how, students from charter and private high schools are overrepresented in the student population, while students from public high schools are underrepresented. One can see in the tables of Appendix D that in 2015, students from private universities represented 18.2% of the total enrollment at universities that have participated in the funding program, while students from public high schools only represented 27.9%. That is a rate of 2 to 3 at higher quality universities, while within overall high school enrollment for the same year, based on Table 1, the rate between private and public high schools was 2 to 9.

One can also see, however, that the number of students from public high schools at participating universities increased after the implementation of the 2015 CEL, while total enrollment of students from private high schools remains relatively stable throughout the period.

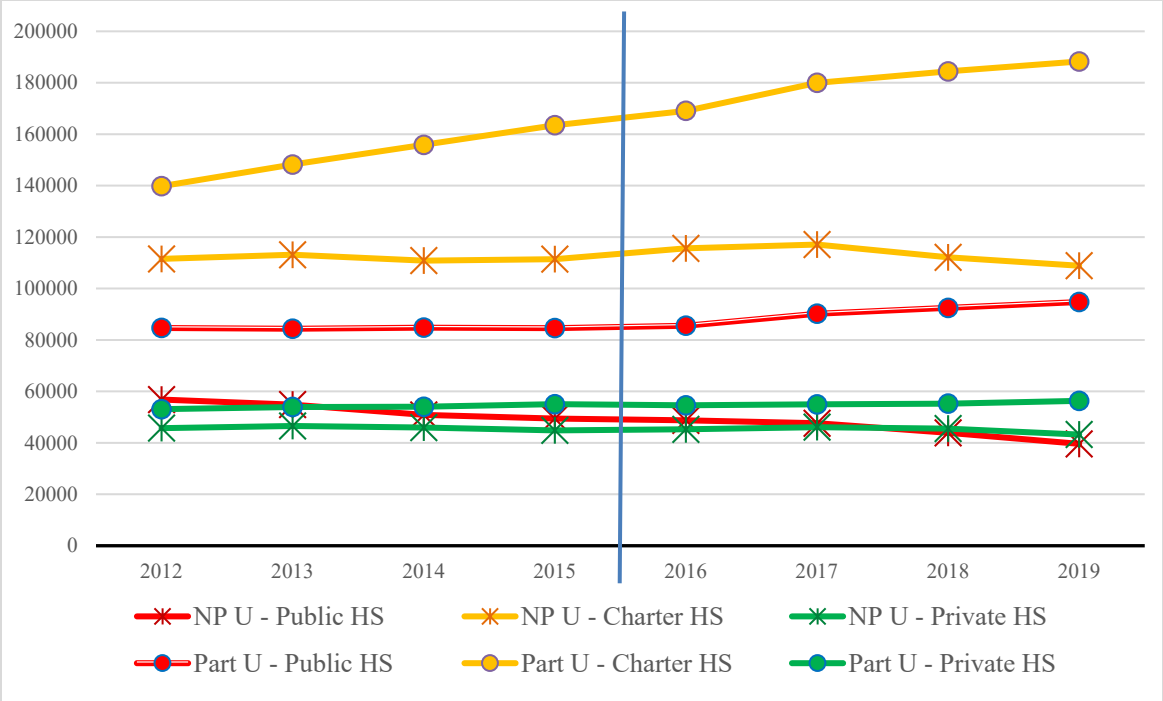


*Figure 1.* Line chart showing enrollment by type of High School according to the status of the University in the 2015 CEL between 2012 and 2019

Looking at enrollment in STEM programs by type of high school in Figure 2 on the next page, representation is even lower for students who graduated from public high schools. For 2015 at participating universities, for example, students from public high schools represented only 26.5% of enrollment, while students from private high schools amounted to 19.2%. Thus, supporting the argument that social inequalities are in fact increased in STEM enrollment at Chilean Universities.

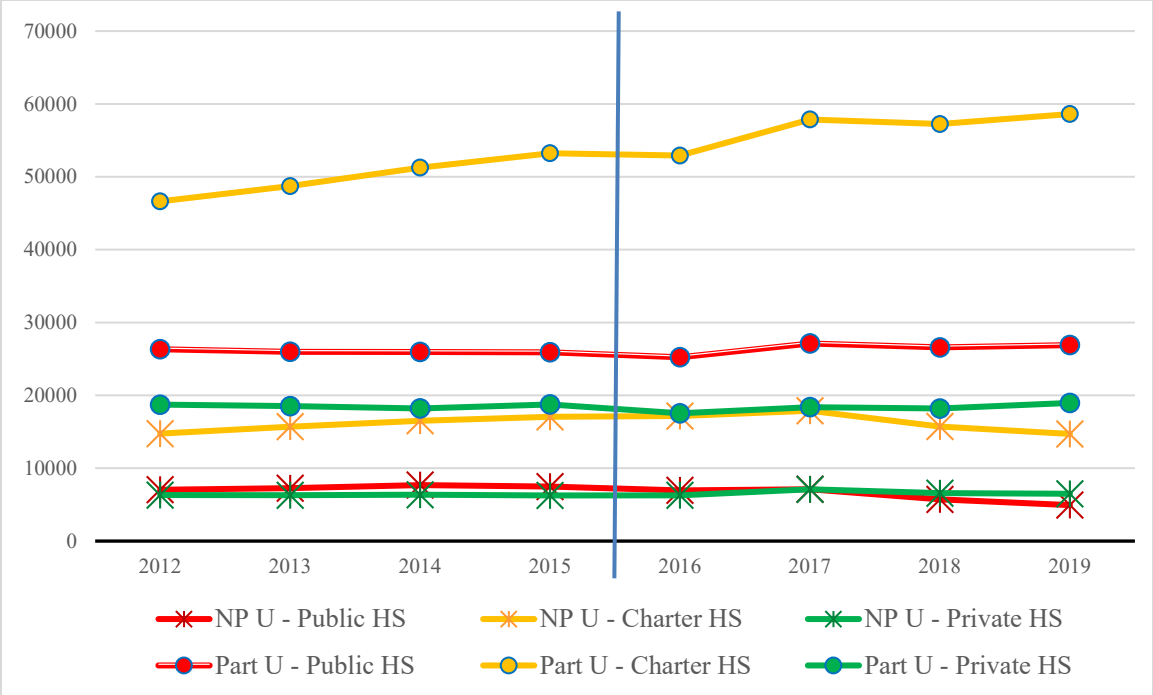


*Figure 2.* Line chart showing enrollment in STEM programs by type of High School according to the status of the University in the 2015 CEL between 2012 and 2019

*Regression Results for Students from Public High Schools*

The Ordinary Least Squares (OLS) regression models in Table 3 present the results for the first set of hypotheses. Due to the dependent variable being transformed using inverse hyperbolic sine, results must be interpreted in terms of percentage increased in the dependent variable's value. Thus, one can observe in Model 2 that an undergraduate program being in STEM did not have a significant effect for the number of students from public high school enrolled in them before the implementation of the 2015 Law, net of the other independent and control variables. After the implementation it does present a statistically significant effect, but a negative one, as shown in Model 4, where the full model for the period of implementation of the law is presented. One could interpret that a program being in STEM between 2016 and 2019 is associated with a -3,63% decrease in the number

of students from a public high school, net of all the other independent and control variables.

The variables relating to size of the incoming and previous cohorts are positively associated with the number of students enrolled in the Undergraduate Degree Programs in both periods analyzed, as is the Gender Parity Index (GPI) of the previous cohorts. Due to the fact that they are transformed, they must be interpreted in terms of a percentage increase. For example, a 10% increase in first year enrollment in Model 4 is associated with a 2,76% increase in the number of students that came from public high schools, net of the other independent and control variables.

In Model 2, one can see that the effect of a University having participated in the funding program had a significant effect on the number of public high graduates that are enrolled in undergraduate degree programs. According to Model 2, participating Universities are associated with a 15.49% increase in the number of students from public high schools, when contrasted with universities that have not participated in the funding initiative, net of the other independent and control variables. In Model 4, however, during the period of implementation of the 2015 CEL, the effect of a University having participated in the funding benefit is interpreted as an increase of 27.25%.

We also see in Table 3 that the control variables are statistically significant in both periods, and that the effects of UDPs having night classes were negative in the 2012 to 2015 period, but positive between 2016 and 2019. Undergraduate Degree Programs imparted at State Universities had approximately 22.02% more students

from public high schools enrolled in them before the implementation of the 2015 CEL, net of the other variables in the models, and 17.69% more afterwards when compared to non-State Universities. Undergraduate Degree Programs taught at the Chilean Capital and the number of semesters to completion have a significant negative effect on the percentage of students from public high schools enrolled in them in both periods, net of the other independent and control variables.

Table 3.

*OLS Regression Predicting that implementation of the 2015 law will improve enrollment of students from public high schools at participating Universities*

| | 2012-2016 Period | | 2016-2019 Period | |
|---|---|---|---|---|
| Variables | M1 - Initial | M2 - Full Model | M3 - Initial | M4 - Full Model |
| STEM | 0.057*** | 0.011 | -0.007 | -0.037* |
| | (0.017) | (0.016) | (0.015) | (0.015) |
| Incoming Cohort Enrollment | 0.251*** | 0.256*** | 0.278*** | 0.286*** |
| | (0.009) | (0.009) | (0.011) | (0.011) |
| Previous Cohorts Enrollment | 0.569*** | 0.617*** | 0.535*** | 0.587*** |
| | (0.009) | (0.009) | (0.009) | (0.011) |
| Previous Cohorts GPI | 0.042*** | 0.027*** | 0.024*** | 0.022*** |
| | (0.006) | (0.005) | (0.006) | (0.005) |
| Participating Universities | 0.369*** | 0.144*** | 0.398*** | 0.241*** |
| | (0.013) | (0.015) | (0.013) | (0.014) |
| State Administered | | 0.199*** | | 0.162*** |
| | | (0.013) | | (0.012) |
| Chilean Capital | | -0.503*** | | -0.411*** |
| | | (0.012) | | (0.011) |
| Night Classes | | -0.089*** | | 0.144*** |
| | | (0.015) | | (0.014) |
| Semesters to Completion | | -0.036*** | | -0.017*** |
| | | (0.003) | | (0.003) |
| Constant | 0.481*** | 0.870*** | 0.533*** | 0.597*** |
| | (0.030) | (0.036) | (0.031) | (0.037) |
| Observations | 11,435 | 11,435 | 10,601 | 10,601 |
| R-squared | 0.659 | 0.716 | 0.676 | 0.721 |

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

*Results Comparing Distribution of Students from Charter and Private High Schools*

In Table 4, on the next page, one can observe the effects of the independent variables for the percentage of students enrolled in undergraduate degree programs that come from charter, and private high schools. The full models follow the same order for variables than in Table 3 in the previous section, which allows in the next table of this section, Table 4, to compare the full models during the period of implementation of the 2015 Chilean Education Law.

Throughout Table 4, one can observe that an undergraduate program being in STEM has a statistically significant positive effect on the proportion of students from both charter and private high schools. The highest positive effect for STEM would be in Model 8, where the coefficient can be interpreted as the fact that a program is in STEM is associated with a 15.95% increase in the number of students from private high schools enrolled in them, net of the other independent and control variables.

The size of first-year and previous cohorts are positively associated with the number of students from both charter and private high schools. However, one can observe that the Gender Parity Index does not have a statistically significant effect for either of the two periods for the number of students from charter schools, and a statistically significant negative effect with the number of students from private schools.

In Models 5 and 6, one can observe that the effect on the number of students from charter schools of a participating University was statistically significant and positive. This effect was 6.5% before the implementation of the law and 6.82% afterwards. For the number of students from private high schools, the status of the University was significant and positive before the 2015 CEL was implemented, associated with a 14.22% increase,

but in the period after the application of the 2015 CEL, the effect is not statistically significant.

Table 4.

*OLS Regression Predicting that during the implementation of the 2015 CEL, enrollment from charter and private schools will decrease at participating universities*

| | Charter High Schools | | Private High Schools | |
|---|---|---|---|---|
| Variables | M5 - 2012 to 2015 | M6 - 2016 to 2019 | M7 - 2012 to 2019 | M8 - 2016 to 2019 |
| STEM | 0.077*** | 0.041*** | 0.120*** | 0.148*** |
| | (0.012) | (0.012) | (0.030) | (0.030) |
| Incoming Cohort Enrollment | 0.303*** | 0.289*** | 0.436*** | 0.440*** |
| | (0.008) | (0.010) | (0.016) | (0.022) |
| Previous Cohorts Enrollment | 0.645*** | 0.643*** | 0.642*** | 0.682*** |
| | (0.009) | (0.010) | (0.016) | (0.019) |
| Previous Cohorts GPI | 0.007 | 0.004 | -0.096*** | -0.105*** |
| | (0.004) | (0.004) | (0.010) | (0.011) |
| Participating Universities | 0.063*** | 0.066*** | 0.133*** | -0.047 |
| | (0.011) | (0.010) | (0.030) | (0.029) |
| State Administered | 0.024* | -0.014 | -0.487*** | -0.410*** |
| | (0.010) | (0.009) | (0.031) | (0.029) |
| Chilean Capital | 0.054*** | -0.011 | 0.708*** | 0.809*** |
| | (0.009) | (0.008) | (0.023) | (0.023) |
| Night Classes | -0.552*** | -0.425*** | -1.007*** | -0.963*** |
| | (0.014) | (0.014) | (0.029) | (0.032) |
| Semesters to Completion | 0.010** | 0.021*** | 0.087*** | 0.065*** |
| | (0.003) | (0.003) | (0.006) | (0.006) |
| Constant | 0.707*** | 0.782*** | -2.722*** | -2.622*** |
| | (0.033) | (0.031) | (0.068) | (0.075) |
| Observations | 11,411 | 10,600 | 11,411 | 10,600 |
| R-squared | 0.840 | 0.850 | 0.590 | 0.592 |

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Among the control variables in Models 6 and 8, one can see that an undergraduate degree program being taught in the Chilean Capital has a very high effect for the number of students from private high schools in both periods studied, but only for the number of students from charter schools enrolled before the implementation of the 2015 CEL.

Classes being taught at night, however, is associated with a significant negative for charter and private high schools.

To assess whether the implementation of the 2015 Chilean Education Law had a significant effect at Participating Universities during its implementation, the following table presents the X-standardized results, for the same 10,600 cases that were valid for models 4, 6, and 8 in the previous two tables. One can see in Table 5 that undergraduate programs in STEM are associated with a negative effect on the enrollment of students from public high schools, but a positive effect on enrollment of students from charter and private ones, net of the other independent and control variables in the full model. The highest standardized effect of an undergraduate degree program being in STEM is for the number of students from private high schools.

Table 5 also shows how, net of the other independent variables, GPI is positively associated with enrollment of students from public high schools, not significantly associated with enrollment from charter high schools and negatively associated with enrollment from private ones. Regarding the status of the University, we can see that net of the other variables, the x-standardized effect of a university participating in the funding initiative has a significant and much higher positive effect for enrollment of students from public high schools than from charter and private ones.

The x-standardized coefficients for the control variables also show significant aspects of segregation in higher education in Chile. For example, an undergraduate program being taught at a State University has a positive effect on the number of students from public high schools, but a negative effect on the number of private high school students, net of the other independent and control variables in models 4, 6 and 8. The fact

that a program is taught in the Chilean capital has a statistically significant negative effect on the number of students from public high schools that are enrolled, as does the number of semesters to completion, but these independent variables have either positive or non-significant effects on the number of students from charter and public high schools. Finally, the fact that an undergraduate program is taught at night has a positive effect for the number of students from public high schools enrolled in them, but statistically significant negative effects for the number of students from charter and private high schools that are enrolled in them.

Table 5.

*X-standardized OLS coefficients comparing effects for each type of high school during the implementation of the 2015 CEL*

| Variables | Model 4<br>Public HS | Model 6<br>Charter HS | Model 8<br>Private HS |
|---|---|---|---|
| STEM | -0.016* | 0.018*** | 0.066*** |
| Incoming Cohort Enrollment | 0.259*** | 0.262*** | 0.398*** |
| Previous Cohorts Enrollment | 0.63*** | 0.69*** | 0.731*** |
| Previous Cohorts GPI | 0.03*** | 0.005 | -0.146*** |
| Participating Universities | 0.12*** | 0.033*** | -0.024 |
| State Administered | 0.073*** | -0.006 | -0.184*** |
| Chilean Capital | -0.199*** | -0.005 | 0.392*** |
| Night Classes | 0.054*** | -0.158*** | -0.358*** |
| Semesters to Completion | -0.037*** | 0.045*** | 0.14*** |
| Constant | | | |
| Observations | 10,600 | 10,600 | 10,600 |
| R-squared | 0.720 | 0.850 | 0.590 |

*** p<0.001, ** p<0.01, * p<0.05

*Analysis of Gender Distribution within Overall Enrollment*

Figure 3 offers a relevant insight about gender segregation in Chilean higher education. One can see there that the biggest different in enrollment, which explains the country's positive GPI, is at the non-participating universities, which are identified as lower quality institutions, based on the stipulations of the 2015 CEL. Furthermore, at participating universities, one could say that the increase in female enrollment has been following a linear trend and that after the 2015 law it is the first time that females clearly surpassed males in enrollment at higher quality institutions.

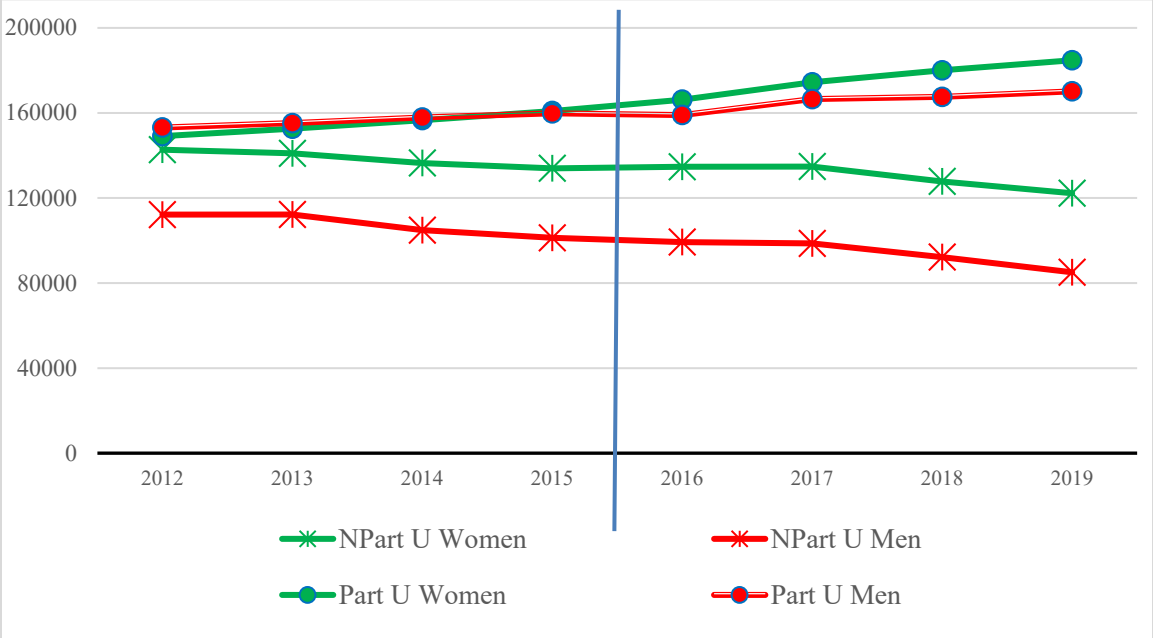


*Figure 3.* Line chart showing overall enrollment distribution by Gender according to the status of the University in the 2015 CEL between 2012 and 2019

Figure 4, in the next page, illustrates gender segregation with a clear picture as to how first-year enrollment is distributed. In 2012, in fact, there were more women entering undergraduate programs at non-participating universities than at universities that have

participated in the funding benefit. Also, first-year female enrollment only surpassed the total number of males after 2015.

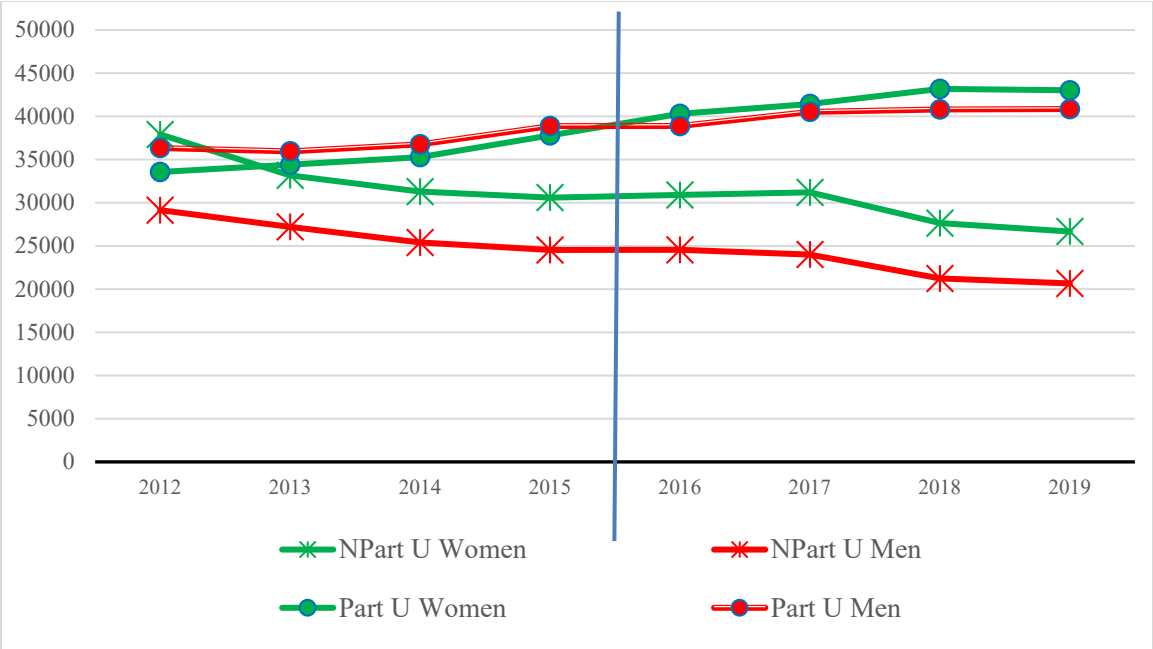


*Figure 4.* Line chart showing first-year enrollment by Gender according to the status of the University in the 2015 CEL between 2012 and 2019

*Regression Results for Gender Parity in Overall Enrollment*

In Table 6, one can see that a program being in STEM has a significant negative effect on Gender Parity, net of the other variables in Models 9 and 11. The coefficient of -1.848 in Model 11 can be interpreted as a program being in a STEM field is associated with a -84.2% decrease in the ratio of females to males when compared to those not in STEM fields, net of the other independent and control variables in the model.

For the cohort size variables, Table 6 shows that in the full model, Model 11, the size of the first-year incoming cohort has a significant positive effect on total GPI within an undergraduate program. The effect of the size in enrollment for previous cohorts, however, is not statistically significant in the full model.

Regarding the period of application of the 2015 CEL in Model 11 one can see that neither the constitutive term nor the interaction term are significant. The constitutive term for the status of the University, however, is negative, indicating that prior to the application of the 2015 CEL, universities that would participate in the funding initiative had a negative effect on total GPI when compared to those universities that have not participated in the initiative. The negative coefficient for Participating Universities in Model 11 can be interpreted as a decrease of -9.52% in Total GPI, net of the other variables in the model.

Regarding the control variables, in Model 11 one can see that an undergraduate degree program is taught at a State University is associated with an 8.87% increase in the Gender Parity Index, net of the other variables in the model. UDPs taught at the Chilean Capital are associated with a -9.15% decrease in Total GPI, net of the other variables in Model 11. Undergraduate degree programs whose classes are taught at night are associated with a -31.41% decrease in GPI, net of the other variables in Model 11.

Model 12 in Table 6 presents the results for only undergraduate programs in STEM, in order to determine whether the interaction between the status of the University according to the 2015 CEL and its period of implementation had had a significant effect on Total GPI. Results, however, show that the interaction term is not statistically significant.

Table 6.

*OLS Regression Predicting that the interaction between status of Universities according to the 2015 CEL and its period of implementation has had a positive effect on the total ratio of females to males for all Undergraduate Programs and in STEM*

| Variables | M9<br>Initial | M10<br>With<br>Interaction | M11<br>Full Model | M12<br>STEM |
|---|---|---|---|---|
| STEM | -1.851*** | -1.851*** | -1.848*** | (omitted) |
| | (0.017) | (0.017) | (0.017) | |
| Incoming Cohort Enrollment | 0.071*** | 0.071*** | 0.073*** | 0.066*** |
| | (0.010) | (0.010) | (0.010) | (0.019) |
| Previous Cohorts Enrollment | 0.052*** | 0.052*** | 0.018 | -0.222*** |
| | (0.009) | (0.009) | (0.010) | (0.019) |
| Participating Universities | 0.023 | 0.017 | -0.100*** | 0.552*** |
| | (0.015) | (0.021) | (0.024) | (0.051) |
| 2016-2019 Period | 0.041** | 0.036 | 0.025 | 0.033 |
| | (0.015) | (0.022) | (0.022) | (0.046) |
| Participating Universities x 2016-2019 Period | | 0.012 | 0.022 | -0.017 |
| | | (0.029) | (0.029) | (0.058) |
| State Administered | | | 0.085*** | 0.018 |
| | | | (0.020) | (0.037) |
| Chilean Capital | | | -0.096*** | 0.296*** |
| | | | (0.015) | (0.031) |
| Night Classes | | | -0.377*** | -0.642*** |
| | | | (0.020) | (0.042) |
| Semesters to Completion | | | 0.003 | 0.049*** |
| | | | (0.004) | (0.008) |
| Constant | 0.054 | 0.056 | 0.316*** | -1.315*** |
| | (0.031) | (0.032) | (0.045) | (0.091) |
| Observations | 22,036 | 22,036 | 22,036 | 5,818 |
| R-squared | 0.369 | 0.369 | 0.381 | 0.133 |

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

*Regression Results for Gender Parity in First-Year Enrollment*

In Table 7, one can observe that the coefficient for an undergraduate program being in STEM is statistically significant and negative. The coefficient of -0.176 in Model 15 can be interpreted as a decrease of -16,14% in Gender Parity Index associated with an Undergraduate Program being in STEM, when contrasted with those who are non-STEM ones.

The size of the first-year cohort in Model 15 has a statistically significant effect on First-year Gender Parity Index. The coefficient of 0.21% can be interpreted as a 10% increase in the size of the first-year cohort is associated with a 0.86% increase in First-year Gender Parity Index, net of the other independent and control variables in Model 15. The size of enrollment for previous cohorts, however, does not have a statistically significant effect on first-year Gender Parity Index in Model 15.

One can see that the GPI of the previous cohorts has a considerable effect on First-year GPI. The coefficient of 0.841 can be interpreted as implying that a 10% increase in the GPI of previous cohorts is associated with an 8.35% increase in the First-year GPI of undergraduate degree programs, net of the other independent and control variables.

Once can observe in Model 15 that the constitutive terms for the interaction, as well as the interaction term, are all statistically significant, although their coefficients have different signs. The negative coefficient of -0.046 for the constitutive term for Participating Universities can be interpreted as a -4.5% decrease in First-year Gender Parity Index for Undergraduate Degree Programs taught at universities that have participated in the funding initiative when contrasted with those that have not

participated, during the period prior to the implementation of the 2015 CEL, net of the other independent and control variables in Model 15. The negative coefficient of -0.063 for the constitutive term regarding the period of implementation of the law, between 2016 and 2019, can be interpreted as implying that undergraduate programs taught during this period at universities that have not participated in the funding is associated with a -6.11% decrease in First-year Gender Parity Index when compared to the undergraduate degree programs taught at non-participating universities before the implementation of the 2015 Education Law, net of the other independent and control variables in Model 15.

The interaction term between participating universities and the period of implementation of the 2015 Chilean Education Law, unlike the constitutive terms, shows a positive effect on GPI among first-year students in Model 15 and even in Model 16, which refers exclusively to STEM programs. For the overall sample, we can interpret the 0.099 coefficient as an undergraduate degree program being taught at a participating university during its implementation is associated with a 10.41% increase.

Among the control variables in Model 15, one can see that an undergraduate program being imparted at a State University is not associated with a significant effect. Nonetheless, an undergraduate program taught in the Chilean Capital is associated with a -4.02% decrease in First-rear GPI, net of the other variables. Undergraduate Degree Programs whose classes take place at night are associated with a 7.04% decrease in First-year GPI when contrasting them with those whose classes are taught during the day, net of the other independent and control variables of Model 15. Finally, a one unit increase in semesters to completion is associated with a 0.5% increase in First-Year GPI.

Table 7.

*OLS Regression Predicting that the interaction between status of Universities according to the 2015 CEL and its period of implementation has had a positive effect on the ratio of females to males in first-year cohorts for all Undergraduate Programs and in STEM*

| Variables | M13 Initial | M14 With Interaction | M15 Full Model | M16 STEM |
|---|---|---|---|---|
| STEM | -0.170*** | -0.169*** | -0.176*** | (omitted) |
| | (0.012) | (0.012) | (0.012) | |
| Incoming Cohort Enrollment | 0.018 | 0.016 | 0.022* | -0.163*** |
| | (0.009) | (0.009) | (0.009) | (0.017) |
| Previous Cohorts Enrollment | 0.008 | 0.010 | -0.003 | 0.090*** |
| | (0.007) | (0.007) | (0.008) | (0.015) |
| Previous Cohorts GPI | 0.845*** | 0.845*** | 0.841*** | 0.806*** |
| | (0.005) | (0.005) | (0.005) | (0.009) |
| Participating Universities | 0.014 | -0.034** | -0.046*** | -0.025 |
| | (0.008) | (0.012) | (0.013) | (0.031) |
| 2016-2019 Period | -0.010 | -0.060*** | -0.063*** | -0.061 |
| | (0.008) | (0.012) | (0.012) | (0.032) |
| Participating Universities x 2016-2019 Period | | 0.097*** | 0.099*** | 0.088* |
| | | (0.016) | (0.016) | (0.037) |
| State Administered | | | -0.010 | -0.014 |
| | | | (0.011) | (0.020) |
| Chilean Capital | | | -0.041*** | 0.017 |
| | | | (0.008) | (0.019) |
| Night Classes | | | -0.073*** | -0.073* |
| | | | (0.013) | (0.031) |
| Semesters to Completion | | | 0.005* | -0.008 |
| | | | (0.003) | (0.004) |
| Constant | -0.071** | -0.052* | -0.023 | 0.102 |
| | (0.024) | (0.025) | (0.030) | (0.060) |
| Observations | 20,759 | 20,759 | 20,759 | 5,285 |
| R-squared | 0.796 | 0.796 | 0.797 | 0.696 |

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

For Model 16, which refers exclusively to Undergraduate Degree Programs in STEM, one can see that that the interaction term has a positive coefficient equal to 0.088, which is statistically significant with a p-value lower than 0.05. This can be interpreted as saying that STEM programs being taught at universities that have participated in the funding initiative based on the 2015 Chilean Education Law during its period of

implementation between 2016 and 2019 are associated with a 9.2% increase in First-year Gender Parity Index, net of the other independent and control variables in Model 16.

# CHAPTER FOUR

## Discussion and Conclusions

### *Discussion*

Observing the results, we find enough evidence to support most of the research hypotheses that were set in Chapter 2. stating that undergraduate programs taught at Universities participating in the funding initiative based on the 2015 Law would have a statistically significant effect on the proportion of students from public high schools that are enrolled in undergraduate degree programs, as well as on the ratio of females enrolling in first-year cohorts.

*Hypotheses Related to Type of High School*

*H1a* – If the 2015 Chilean Education Law had a positive effect on class inequalities, then undergraduate programs at Universities where the funding is available will see a positive significant increase in enrollment by students from public high schools, net of cohort size, academic field, gender parity in previous cohorts, and other control variables. (supported)

*H1b* – If the 2015 Chilean Education law had an equalizing horizontal effect, then undergraduate degree programs across all academic fields will see an increase of students from public high schools, net of other independent and control variables. (unsupported)

*H1c* – If social class is intersected with gender within undergraduate degree programs, then gender parity in previous cohorts will have a positive effect on the

number of students from public high schools at universities in which the funding is available, net of other independent and control variables (partially supported).

Results shown in Table 3 imply that there is support for hypothesis 1a, as UDPs imparted at participating universities during the period of implementation of the 2015 CEL were significantly and positively associated with an increase in enrollment by students from public high schools, when compared to the universities that have not participated in the funding initiative.

Furthermore, results shown in Table 4 appear to support the notion that the different characteristics for which the models have accounted in the independent and control variables have distinct and significant effects for the number of students enrolled from public high schools, which are significantly different for the effects on the number of students from charter and private high schools.

There was no support found for hypothesis 1b, as the effect of an undergraduate program being in STEM on the number of students from public high schools was significantly negative in the period of implementation of the Law and had an increased significance when compared to the period before the implementation of the 2015 Law. Further analyses on this issue attached in Appendix D continued to yield significant and increasingly negative results for the coefficient of a program being in STEM at participating universities during the 2015 CEL implementation.

There was partial support for hypothesis 1c, since Prior GPI had a positive effect on the number of students from public high schools, net of the other variables in the period after the implementation of the law. However, further analysis showed a negative relation between GPI and the number of students from public high schools. This implies

that, even though the thesis found that the implementation of the 2015 CEL had a significant effect for increasing participation of underrepresented groups, these two increases did not occur in the same undergraduate degree programs. Further analysis where, instead of having the undergraduate programs as unit of analysis, working with a dataset that has individual-level data could, however, yield different results.

*H2a* – If the 2015 CEL improved access and retention for low income students, given that undergraduate degree programs have limited spots in their cohorts, then the number of students from charter and private high schools will decrease at Universities where funding is available, net of other independent and control variables (partial support)

The implementation period of the 2015 CEL at participating universities did have a significant negative effect on the number of students from private high schools, as shown in Tables 3 and 4, but it was not statistically significant for the dependent variable considering the number students from charter schools that are enrolled in undergraduate degree programs at participating universities. This could suggest that income inequalities are more pronounced between students from these two types of high schools than originally expected, but answering this question is beyond the scope of the thesis.

*Hypotheses Related to Gender Parity in Overall Enrollment*

*H3a* – The interaction between the implementation of the 2015 CEL and Universities that have participated funding will have a positive effect on total female enrollment in undergraduate degree programs that are eligible (unsupported)

*H3b* – The interaction between the implementation of the 2015 CEL and Universities that have participated funding will have a positive effect on total female enrollment in undergraduate degree programs across all academic fields (unsupported)

Results relating to these two hypotheses showed that there was no support to accept them. Thus, the Gender Parity Index of total enrollment was not significantly affected by the interaction of the Universities that participated in the funding benefits of the 2015 CEL and its period of implementation. Also, there was no support for sustaining that the interaction term had a significant effect on the GPI for the entire student body of undergraduate programs in STEM.

Based on the literature review, this means that there was no increase in gender parity among those students who are enrolled in undergraduate degree programs imparted at higher quality universities and higher prestige academic fields. Further analysis using hierarchical models might identify that GPI at some institutions has improved over the past eight years.

*Hypotheses Related to Gender Parity in First-Year Enrollment*

*H4a* – If the Chilean 2015 Education Law had a positive effect on gender parities in incoming cohorts, then the interaction between the application of the 2015 CEL and Universities where the funding is available will have a positive effect on Gender Parity within undergraduate degree programs, net of other independent and control variables. (supported)

*H4b* – If the Chilean 2015 Education law had a horizontal effect on gender disparities, then undergraduate degree programs across all academic fields at Universities where the funding has been available will have a positive effect on Gender Parity within

STEM undergraduate degree programs, net of other independent and control variables. (supported)

The analysis has found support for both of these hypotheses, indicating that the 2015 CEL has had a significant positive effect on gender parity for cohorts entering at higher quality institutions and at higher prestige academic fields, since the interaction terms in Table 6 had a statistically significant positive effect. Thus, as the literature mentioned, it is necessary to not just look at indicators at the macro-level, because mid-level analyses, between institutional and individual, can offer a richer perspective on the reality of social and cultural inequalities.

These findings can be interpreted as providing support for the notion that at least a portion of gender inequality within undergraduate degree programs at Chilean universities is due to structural aspects, such as income inequality. This is particularly salient because the models to test these hypotheses on first-year gender parity were accounting for the effect of Gender Parity in previous cohorts, which was extremely high. Thus, findings would offer support to the critical perspective that poses that structural inequalities can be layered with gender and cultural inequalities and that general public policies can have a positive impact on aspects of inequality that they were not originally intended to improve.

Even though it was not possible to perform a proper intersectional analysis between class and gender the data that was available, these results are encouraging for accessing other datasets that can complement the analysis performed with the Chilean SIES data.

Furthermore, the effect of the interaction of participating universities and the period of implementation of the 2015 CEL was also significant in STEM programs, indicating that the ratio of females to males in STEM has increased at those institutions where the benefits have been available from 2016 to 2019. As research on gender inequalities in higher education ahs mentioned, it is important to identify if an overall increase of female enrollment has occurred at higher quality institutions and also at higher prestige academic fields.

### *Conclusions*

This thesis had the goals of analyzing the effect of legislation to reduce income inequality and how it had significant effects on social class, which would be reasonably expected, and on gender parity, which was not a manifest intent of the 2015 Chilean Education Law. The analysis presented in the thesis has shown that income inequality significantly crosses both class and gender disparities in higher education, even though it was unable to measure the intersectionality of the effects. Methodologically, the thesis also expected to set the basis for further analysis that works with more detailed data.

The analysis presented in this paper demonstrates that the 2015 law has had a positive effect on low-income population and on female enrollment in Chilean Undergraduate Degree Programs. For female enrollment, the main effect was observed among first-year students, signifying how the law focusing on income inequality affected gender disparities at top-tier universities, which was not a manifest intent of the law. Such effect was significant even when accounting for prior gender enrollment, male enrollment, the geographic location where the program is taught, and for whether the program is in STEM or not.

For this work, the outcome variables chosen did prove to be related to the independent factors, both in the substantive terms and also making a contribution to the methodological use of these variables. The three main options for the type of high school that students come from, covers most of the options and the side by side analysis showed how different independent variables can have distinct effects on each population. On the other hand, the Gender Parity Index, calculated as the number of females divided by males to produce a ratio, allows for representation of the full spectrum of the two categories for this variable with one.

This study has set the basis for further inquiries on the effects of funding for the low-income students in higher education in terms of access, resource, and outcome inequalities that cross the divide between class and gender disparities. In future studies, I would suggest considering the temporal relations between higher education and local development, using other relevant data about Chile such as Census information (last version was 2017 and in Chile it does ask about education) and the National Social and Economic Characterization Survey (done every 2 years with a quarter million respondents in Chile). This information may become the basis for a wider analysis of Higher Education in Latin America, including qualitative analyses of its laws, as well as quantitative studies of enrollment, graduation, and employability.

# APPENDICES

# APPENDIX A

Table A-1. *Gender Parity Index as an accurate estimator of the difference in effects on Total Number of Females and Males*

| Variables | Females | Males | Female Coeffs - Male Coeffs | Gender Parity Index (GPI) | GP Index - MF Difference |
|---|---|---|---|---|---|
| STEM | -0.272 | -0.096 | -0.176 | -0.176 | 0 |
| | (0.008) | (0.007) | | (0.012) | |
| Incoming Cohort Enrollment | 1.003 | 0.981 | 0.022 | 0.022 | 9.02056E-17 |
| | (0.005) | (0.005) | | (0.009) | |
| Previous Cohorts Enrollment | -0.014 | -0.011 | -0.003 | -0.003 | 0 |
| | (0.004) | (0.005) | | (0.008) | |
| Previous Cohorts GPI | 0.386 | -0.455 | 0.841 | 0.841 | 0 |
| | (0.003) | (0.004) | | (0.005) | |
| Participating Universities | 0.04 | 0.086 | -0.046 | -0.046 | 0 |
| | (0.008) | (0.009) | | (0.013) | |
| 2016-2019 Period | -0.023 | 0.039 | -0.062 | -0.063 | -0.001 |
| | (0.007) | (0.008) | | (0.012) | |
| Participating Universities x 2016-2019 Period | 0.041 | -0.058 | 0.099 | 0.099 | 0 |
| | (0.010) | (0.011) | | (0.016) | |
| State Administered | -0.002 | 0.008 | -0.01 | -0.01 | 0 |
| | (0.007) | (0.007) | | (0.011) | |
| Chilean Capital | -0.002 | 0.039 | -0.041 | -0.041 | 0 |
| | (0.005) | (0.006) | | (0.008) | |
| Night Classes | -0.024 | 0.049 | -0.073 | -0.073 | 0 |
| | (0.008) | (0.008) | | (0.013) | |
| Semesters to Completion | 0.016 | 0.011 | 0.005 | 0.005 | 0 |
| | (0.002) | (0.002) | | (0.003) | |
| Constant | -0.914 | -0.89 | -0.024 | -0.023 | 0.001 |
| | (0.018) | (0.018) | | (0.030) | |
| Observations | 20,759 | 20,759 | | 20,759 | |
| R-squared | 0.894 | 0.862 | | 0.797 | |

Robust standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

# APPENDIX B

Table B-1.

*VIF for Non-Interacted Model*

| Variable | VIF | 1/VIF |
|---|---|---|
| STEM | 1.37 | 0.729999 |
| First Year Enrollment | 1.85 | 0.541087 |
| Total Prior Enrollment | 2.12 | 0.470618 |
| Prior IPG | 1.41 | 0.707161 |
| Participating University | 1.73 | 0.577404 |
| 2016-2019 Period | 1.02 | 0.977631 |
| State University | 1.58 | 0.632263 |
| Located in Capital | 1.32 | 0.757724 |
| Night classes | 1.32 | 0.75848 |
| Semesters to Completion | 1.34 | 0.747324 |
| Mean VIF | 1.53 | |

Table B-2.

*VIF for Interacted Model*

| Variable | VIF | 1/VIF |
|---|---|---|
| STEM | 1.37 | 0.729887 |
| First Year Enrollment | 1.85 | 0.540795 |
| Total Prior Enrollment | 2.13 | 0.470193 |
| Prior IPG | 1.41 | 0.707147 |
| Participating University | 2.69 | 0.371534 |
| 2016 to 2019 | 2.06 | 0.484953 |
| Participating Universities x 2016 to 2019 | 3.12 | 0.320465 |
| State University | 1.58 | 0.632223 |
| Located in Capital | 1.32 | 0.757446 |
| Night classes | 1.32 | 0.758422 |
| Semesters to Completion | 1.34 | 0.747275 |
| Mean VIF | 1.81 | |

# APPENDIX C

Table C-1.

*Total Enrollment by Type of High School at Universities participating in the 2015 CEL funding benefit*

| | Participating Universities | | |
|---|---|---|---|
| Year | Public HS | Charter HS | Private HS |
| 2012 | 84677 | 139792 | 53104 |
| 2013 | 84366 | 148211 | 53937 |
| 2014 | 84808 | 155859 | 54038 |
| 2015 | 84610 | 163486 | 55046 |
| 2016 | 85531 | 169086 | 54609 |
| 2017 | 90214 | 179970 | 54976 |
| 2018 | 92493 | 184425 | 55262 |
| 2019 | 94755 | 188285 | 56332 |

Table C-2.

*Total Enrollment by Type of High School at Universities not participating in the 2015 CEL funding benefit*

| | Non-participating Universities | | |
|---|---|---|---|
| Year | Public HS | Charter HS | Private HS |
| 2012 | 56835 | 111522 | 45724 |
| 2013 | 54869 | 113147 | 46561 |
| 2014 | 50853 | 110859 | 45937 |
| 2015 | 49420 | 111425 | 44860 |
| 2016 | 48758 | 115638 | 45259 |
| 2017 | 47628 | 117100 | 46106 |
| 2018 | 43890 | 112126 | 45538 |
| 2019 | 39617 | 108866 | 43231 |

Table C-3.

*Ratios and Proportions in Enrollment according to Type of High School at Universities participating in the 2015 CEL funding benefit*

| | Participating Universities | | |
|---|---|---|---|
| Year | Pub/Priv | Pub/Charter | Pub/Total |
| 2012 | 1.59 | 0.61 | 30.5% |
| 2013 | 1.56 | 0.57 | 29.4% |
| 2014 | 1.57 | 0.54 | 28.8% |
| 2015 | 1.54 | 0.52 | 27.9% |
| 2016 | 1.57 | 0.51 | 27.7% |
| 2017 | 1.64 | 0.50 | 27.7% |
| 2018 | 1.67 | 0.50 | 27.8% |
| 2019 | 1.68 | 0.50 | 27.9% |

Table C-4.

*Ratios and Proportions in Enrollment according to Type of High School at Universities not participating in the 2015 CEL funding benefit*

| | Non-participating Universities | | |
|---|---|---|---|
| Year | Pub/Priv | Pub/Charter | Pub/Total |
| 2012 | 1.24 | 0.51 | 26.5% |
| 2013 | 1.18 | 0.48 | 25.6% |
| 2014 | 1.11 | 0.46 | 24.5% |
| 2015 | 1.10 | 0.44 | 24.0% |
| 2016 | 1.08 | 0.42 | 23.3% |
| 2017 | 1.03 | 0.41 | 22.6% |
| 2018 | 0.96 | 0.39 | 21.8% |
| 2019 | 0.92 | 0.36 | 20.7% |

# APPENDIX D

Table D-1.

*Total Enrollment in STEM Undergraduate Programs by type of High School at Universities participating in the 2015 CEL funding benefit*

| | Participating Universities | | |
|---|---|---|---|
| Year | Public HS | Charter HS | Private HS |
| 2012 | 26326 | 46625 | 18723 |
| 2013 | 25974 | 48715 | 18526 |
| 2014 | 25961 | 51256 | 18204 |
| 2015 | 25908 | 53237 | 18756 |
| 2016 | 25228 | 52916 | 17540 |
| 2017 | 27118 | 57869 | 18379 |
| 2018 | 26587 | 57239 | 18189 |
| 2019 | 26900 | 58608 | 18960 |

Table D-2.

*Total Enrollment in STEM Undergraduate Programs by type of High School at Universities not participating in the 2015 CEL funding benefit*

| | Non-participating Universities | | |
|---|---|---|---|
| Year | Public HS | Charter HS | Private HS |
| 2012 | 7049 | 14750 | 6313 |
| 2013 | 7263 | 15698 | 6288 |
| 2014 | 7683 | 16513 | 6352 |
| 2015 | 7480 | 17050 | 6263 |
| 2016 | 6962 | 17158 | 6286 |
| 2017 | 7117 | 17889 | 7108 |
| 2018 | 5724 | 15725 | 6582 |
| 2019 | 4936 | 14706 | 6489 |

Table D-3.

*Ratios and Proportions in Enrollment in STEM Undergraduate Programs by type of High School at Universities participating in the 2015 CEL funding benefit*

| | Participating Universities | | |
|---|---|---|---|
| Year | Pub/Priv | Pub/Charter | Pub/Total |
| 2012 | 1.41 | 0.56 | 28.7% |
| 2013 | 1.40 | 0.53 | 27.9% |
| 2014 | 1.43 | 0.51 | 27.2% |
| 2015 | 1.38 | 0.49 | 26.5% |
| 2016 | 1.44 | 0.48 | 26.4% |
| 2017 | 1.48 | 0.47 | 26.2% |
| 2018 | 1.46 | 0.46 | 26.1% |
| 2019 | 1.42 | 0.46 | 25.7% |

Table D-4.

*Ratios and Proportions in Enrollment in STEM Undergraduate Programs by type of High School at Universities not participating in the 2015 CEL funding benefit*

| | Non-participating Universities | | |
|---|---|---|---|
| Year | Pub/Priv | Pub/Charter | Pub/Total |
| 2012 | 1.12 | 0.48 | 25.1% |
| 2013 | 1.16 | 0.46 | 24.8% |
| 2014 | 1.21 | 0.47 | 25.2% |
| 2015 | 1.19 | 0.44 | 24.3% |
| 2016 | 1.11 | 0.41 | 22.9% |
| 2017 | 1.00 | 0.40 | 22.2% |
| 2018 | 0.87 | 0.36 | 20.4% |
| 2019 | 0.76 | 0.34 | 18.9% |

# APPENDIX E

## Table E-1.

*Total Enrollment by Gender at Universities according to their participation in the 2015 CEL funding benefit*

| | Non-participating Universities | | Participating Universities | |
|---|---|---|---|---|
| Year | Women | Men | Women | Men |
| 2012 | 142719 | 112197 | 149101 | 153154 |
| 2013 | 141018 | 112236 | 152598 | 155229 |
| 2014 | 136447 | 104867 | 156607 | 157870 |
| 2015 | 133951 | 101279 | 160893 | 159816 |
| 2016 | 134666 | 99270 | 166250 | 159027 |
| 2017 | 134801 | 98633 | 174423 | 166517 |
| 2018 | 127788 | 92209 | 180047 | 167553 |
| 2019 | 122249 | 85064 | 184791 | 170159 |

## Table E-2.

*Ratios and Proportions in Total Enrollment by Gender at Universities according to their participation in the 2015 CEL funding benefit*

| | Participating Universities | | Non-participating Universities | |
|---|---|---|---|---|
| Year | Women/Men | Women/Total | Women/Men | Women/Total |
| 2012 | 0.97 | 0.49 | 1.27 | 0.56 |
| 2013 | 0.98 | 0.50 | 1.26 | 0.56 |
| 2014 | 0.99 | 0.50 | 1.30 | 0.57 |
| 2015 | 1.01 | 0.50 | 1.32 | 0.57 |
| 2016 | 1.05 | 0.51 | 1.36 | 0.58 |
| 2017 | 1.05 | 0.51 | 1.37 | 0.58 |
| 2018 | 1.07 | 0.52 | 1.39 | 0.58 |
| 2019 | 1.09 | 0.52 | 1.44 | 0.59 |

Table E-3.

*First-year Enrollment by Gender at Universities according to their participation in the 2015 CEL funding benefit*

| | Non-participating Universities | | Participating Universities | |
|---|---|---|---|---|
| Year | Women | Men | Women | Men |
| 2012 | 37909 | 29146 | 33560 | 36342 |
| 2013 | 33173 | 27206 | 34403 | 35949 |
| 2014 | 31294 | 25401 | 35283 | 36765 |
| 2015 | 30594 | 24527 | 37799 | 38876 |
| 2016 | 30904 | 24548 | 40299 | 38883 |
| 2017 | 31197 | 24008 | 41429 | 40524 |
| 2018 | 27648 | 21234 | 43183 | 40807 |
| 2019 | 26669 | 20661 | 43019 | 40849 |

Table E-4.

*Ratios and Proportions in First-year Enrollment by Gender at Universities according to their participation in the 2015 CEL funding benefit*

| | Participating Universities | | Non-participating Universities | |
|---|---|---|---|---|
| Year | Women/Men | Women/Total | Women/Men | Women/Total |
| 2012 | 0.92 | 0.48 | 1.30 | 0.57 |
| 2013 | 0.96 | 0.49 | 1.22 | 0.55 |
| 2014 | 0.96 | 0.49 | 1.23 | 0.55 |
| 2015 | 0.97 | 0.49 | 1.25 | 0.56 |
| 2016 | 1.04 | 0.51 | 1.26 | 0.56 |
| 2017 | 1.02 | 0.51 | 1.30 | 0.57 |
| 2018 | 1.06 | 0.51 | 1.30 | 0.57 |
| 2019 | 1.05 | 0.51 | 1.29 | 0.56 |

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