# Labor market outcomes for Short-Cycle Program (SCP) graduates across Chile's regions

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## Abstract

Short-cycle programs (SCPs) play a critical role in preparing workers for rapidly evolving labor markets, particularly in developing economies. In Chile, higher education opportunities are highly concentrated in the capital, potentially creating disparities in access to post-secondary education across regions. This study estimates the labor market outcomes of SCPs at both the national and regional levels by leveraging individual-level data from the Social Information Registry (RIS), which includes high school, college, and labor market information. Using a novel Instrumental Variable (IV) approach, I exploit the exogenous variations in proximity of students' high schools to higher education institutions to identify the causal effects of SCP enrollment. The approach distinguishes between students who would not have enrolled in higher education without an SCP option (expansion margin) and those who would have otherwise enrolled in a university program (diversion margin). The findings will provide insights into the role of SCPs in improving employment prospects and wage growth, addressing gaps in the literature on regional disparities in higher education and labor market outcomes. Given the similar geographic and educational disparities exist in other Latin American countries, the results have broader policy implications for improving equitable access to higher education and workforce development across the region.

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## Introduction

Nowadays, technological changes and developments across the world have caused increasingly rapid changes in the labor market, requiring a more specialized and better-trained labor force along with a higher education (HE) system that can keep pace with the demand. Occupations that require an associate's degree or a non-degree certificate are projected to grow between 2016 and 2026 at a rate of 11% in the United States (Rolen, 2019), and according to the Organization for Economic Co-operation and Development (OECD), the number of students with tertiary education and the percentage of workers between 25 and 64 years old with a tertiary degree has steadily increased since 2010 across most OECD countries (OECD, n.d.).

Short-cycle programs[2] (SCP), which are equivalent to sub-baccalaureate programs in the United States, have been instrumental in supporting this process. Policy leaders rely on these institutions to help people find careers and grow the local economy (Carnevale et al., 2018; Conley, 2007; Dougherty & Lombardi, 2016). These programs have also demonstrated high demand from local labor markets compared to students who graduated from bachelor's degrees in Latin American countries (Ferreyra, 2021; Galindo et al., 2021; Urzúa, 2021). Specifically, in Chile, online job postings requiring a SC credential were seven percentage points higher than those requiring a bachelors' degrees, and in Argentina, postings requiring a SC credential were twelve percentage points higher (Urzúa, 2021).

This study will estimate the labor market returns to SCPs in Chile by using individual-level data provided by the Social Information Registry (RIS in Spanish) from the Ministry of Social Development and Family. By tracking all 12$^{th}$-grade high school students from the 2005 cohort until 2016, I will be able to capture their enrollment in post-secondary institutions (if any) and their entry into the labor market. This project will apply a recent Instrumental Variable (IV) approach that exploits students' longitudinal data and local exogenous variations in the distance to higher education institutions to provide causal estimates of SCPs on labor market outcomes. This statistical model allows for the estimation of the proportion of students who would not have enrolled in higher education without recent post-secondary access expansion (expansion margin), and the proportion of students who would have enrolled in a university program instead (diversion margin).

[2] Usually refer as technical degrees in Chile.

Short-cycle programs have shown positive and significant benefits across different countries and contexts. Within Latin American countries, SCPs have been shown to provide higher probabilities of formal employment and higher wages compared to high school degree holders or bachelor's degree dropouts in Chile, Argentina, and Colombia (Bassi et al., 2012; Carranza et al., 2021; Galindo et al., 2021; Urzúa, 2021). However, not all students today have equitable opportunities to access and enroll in higher education programs, as SC programs usually enroll low-income and non-traditional students from lower socioeconomic backgrounds (Ferreyra, 2021).

My interest in Chile for this project extends beyond the income and education disparities regarding access to higher education. During 2022, the Chilean National Educational Council[3] (CNED in Spanish) documented that more than 50% of all open seats for HE in the country were concentrated in the Metropolitan Region, while the second-largest region in terms of open seats was Valparaíso, with only 11.6%. The country's unusual high population density in the Metropolitan Region has created a situation where the availability of HE outside the country's capital is extremely limited. The distance to a higher education institution has been shown to be a key factor in students' higher education enrollment decisions (Acton, Cortes, Miller, et al., 2024; Acton, Cortes, & Morales, 2024; Carneiro et al., 2017; Doyle & Skinner, 2017; Zhang, 2024). Only a few projects have explored how the expansion of higher education increases post-secondary enrollment across Latin American countries (Ferreyra, Galindo, et al., 2022; Katzkowicz et al., 2023). Ferreyra et al. (2022) utilized a comprehensive longitudinal student dataset and the exogenous variation in local higher education supply to calculate the share of students in the expansion margin and the diversion margin, while also providing the causal labor market effects of SCPs in Colombia.

The evidence on the effect of regional disparities in colleges access across regions on labor outcomes in Chile is currently lacking, to the best of my knowledge. The disparities in distance to higher education institutions, due to high concentration of enrollment seats in one region of the country, may be creating a disparity in college access for students from regions outside the area concentrating the educational institutions. This could potentially reduce the probability of being employed and the return of SC program credentials across the regions. This project will fill this gap in the literature by studying the effects of graduating from a SCP has on workers' labor

[3] Consejo Nacional de Educación in Spanish.

outcomes in Chile, along with potential importance of geographical disparities in access to higher education, by answering the following research questions:

- RQ1: To what extent does graduating from a Short-Cycle (SC) program affect workers' labor market outcomes in Chile?
- RQ2: What is the level heterogeneity in the effects of graduating from a SC program on workers' labor market outcomes across the regions of Chile?
- RQ3: To what extent has the expansion of the SC system has associated with growth in the local economy?

This paper contributes to the literature exploring the relationship between higher education programs and labor market outcomes across Latin American countries (Ferreyra, Galindo, et al., 2022; Katzkowicz et al., 2023; Rodríguez et al., 2016), by being among the few studies that provide causal estimates of the labor market effects of Specialized Professional Certificates (SPCs) in Chile, compared to students' next-best options. Additionally, it addresses the current gap in the literature concerning the potential heterogeneity of these labor market effects across geographic regions, a gap driven by the concentration of higher education access in a single region of the country. Notably, the geographic concentration of enrollment in just one region is not unique to Chile. As Urzúa (2021) documents, Argentina and Peru face of the Latin American higher education system. similar challenges, which makes the results of this study potentially relevant to a broader segment

## Conceptual Framework and Theoretical Model

The theoretical framework of the paper is the classical Human Capital Model (Becker, 1962). Under this framework, people continue studying and obtaining credentials until the cost of obtaining a new degree (loss of wages, tuition, student loans, etc.) exceeds the benefit they could obtain from that degree (increase in productivity, higher wages, better career pathways).

The model of this paper follows Hubbard (2018) and Charles et al. (2018)'s models, in which students' decisions are determined by a personal estimation of their lifetime earnings associated with a particular college choice $c = \{0, A, B\}$, where 0 represents students who graduated from high school and then immediately started working in the labor market, A represents students who chose to enroll in a post-secondary short-cycle focused institution

(known as Technical Inst. and technical training centers in Chile or community colleges in the US), and B represents students whose choice are universities. The costs in the model include not only direct costs, but also psychological costs of learning and transportation costs.

The assumptions of the model are the following. First, the cost of a high school diploma is set at zero, implying that the tuition and fees for other post-secondary options are calculated in terms of the additional amount students need to pay to obtain a higher-level credential. Students attend college for the designated duration and do not drop out of their chosen post-secondary programs. Every student who enrolls in a post-secondary degree program is assumed to successfully complete it and receive the corresponding degree. All students enter the labor market immediately after graduating from college. This model does not consider the possibility of students enrolling in college after completing their initial degree or after starting their careers. Individuals are assumed to graduate from high school at the age of 18 and retire at the age of 65. The psychological costs of learning are assumed to be independent of students' academic abilities. Future expected incomes are adjusted for inflation and vary only with the number of years an individual has been in the labor market, reflecting their job experience. Students do not relocate during their college education to keep transportation costs constant throughout their programs. Direct costs, which include tuition and transportation, are adjusted for inflation and remain constant over time.

With all these assumptions under consideration, there are 3 potential college premiums depending on the students' higher education choice.

1. High school diploma and Immediate Labor Market transition

$$\Pi_i^0 = E\left[\sum_{t=18}^{65} \frac{Y_{i;t-18}^0}{(1+\beta)^{t-18}}\right]$$

2. "Associate's" college (Type-A college)

$$\Pi_i^A = E\left[\sum_{t=20}^{65} \frac{Y_{i;t-20}^A}{(1+\beta)^{t-18}}\right] - \sum_{m=1}^{2}\left[(1+\beta)^m\left(F_A + T_i^A\right)\right] - K_A$$

3. "Bachelor's" college (Type-B college)

$$\Pi_i^B = E\left[\sum_{t=23}^{65} \frac{Y_{i;t-23}^B}{(1+\beta)^{t-18}}\right] - \sum_{m=1}^{5}[(1+\beta)^m(F_B + T_i^B)] - K_B$$

The expected income that individual i receives after working for m years in the labor market, having graduated from college type c, is denoted as $Y_{i;m}^c$. Annual fees and tuition costs for enrolling in a type-c college program are represented by $F_c$. It is assumed that all programs have the same level of fees and tuition, and the cost for high school diplomas is normalized to 0. Additionally, it is assumed that the base fees and tuition costs for B-programs are higher than for A-programs, such that $0 < F_A < F_B$. The living and transportation costs that individual i needs to pay for attending the closest type-c college are denoted as $T_i^c$. The psychological costs of attending a type-c college are represented by $K_c$. Again, the costs for a high school diploma are normalized to 0, and similar to tuition fees, it is assumed that attending a type-B HE institution incurs a higher psychological cost than attending a type-A HE institution, such that $0 < K_A < K_B$. Type-A college programs last for 2 years, while type-B college programs last for 5 years.

This particular study will utilize the changes in distance to SC programs generated by local variations in higher education supply. Returning to the model, currently considering joining the labor market or enrolling in a university program after graduating from high school might change their options after a new SC-focused institution opened nearby. If the decrease in transportation and living costs brought by the opening of the new institution is enough to offset the $\Pi_i{}^0 - \Pi_i{}^j$ where j = {0, B}, and assuming all other factors remain constant, then the supply of HE would be able to make a SC program the better option. The conditions under which a student would choose to study a SC program instead of a university degree or going straight to the labor market after a new SC-focused campus opens nearby are the following:

i. Diversion margin

$$\Pi_i^A > \Pi_i^B$$

$$E\left[\sum_{t=20}^{65} \frac{Y_{i;t-20}^A}{(1+\beta)^{t-18}}\right] - \sum_{m=1}^{2}\left[(1+\beta)^m\left(F_A + T_i^A\right)\right] - K_A$$

$$> E\left[\sum_{t=23}^{65} \frac{Y_{i;t-23}^B}{(1+\beta)^{t-18}}\right] - \sum_{m=1}^{5}[(1+\beta)^m(F_B + T_i^B)] - K_B$$

Here, the decrease in the cost of living and transportation for enrolling in a SCP institution ($T_i^A$), caused by the opening of a new SC-focused campus, offsets the difference in expected college premiums between enrolling in a SCP institution and a university.

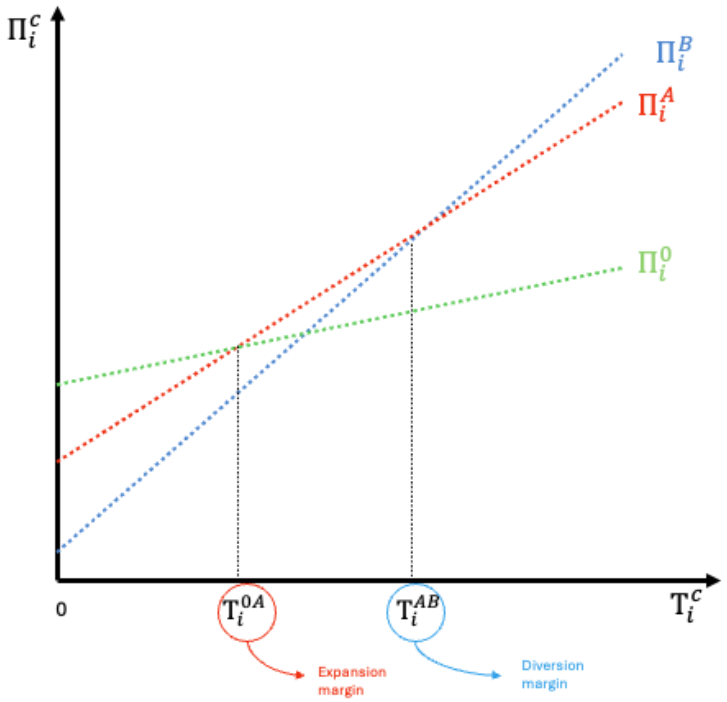
ii. Expansion margin

$$\Pi_i^A > \Pi_i^0$$

$$E\left[\sum_{t=20}^{65} \frac{Y_{i;t-20}^A}{(1+\beta)^{t-18}}\right] - \sum_{m=1}^{2}\left[(1+\beta)^m\left(F_A + T_i^A\right)\right] - K_A > E\left[\sum_{t=18}^{65} \frac{Y_{i;t-18}^0}{(1+\beta)^{t-18}}\right]$$

In the expansion margin, before treatment, the cost of enrollment ($F_A$), living and transportation ($T_i^A$), and lost wages made enrolling in a SCP an unviable option for certain students. After the establishment of a SC-focused campus nearby, the decrease in $T_i^A$ reduces the financial burden of the immediate investment needed to enroll in a SCP, encouraging students to enroll.

Figure 1: Economic Model of College Attendance regarding Transportation cost



Several studies have documented that decreasing the cost of attending college translates into an increase in the probability of college enrollment. When the reduction in the cost of attending college is due to lower annual tuition, the literature suggests that for each $1,000 dollars decrease in tuition, the probability of enrollment increases by 3 to 5 percentage points (Deming & Dynarski, 2010; Page & Scott-Clayton, 2016). This effect may be even higher for community college, as they typically serve lower-income populations with higher elasticity to changes in college prices (Denning, 2017). Particularly in Chile, tuition reduction has also been found to be associated with an increase in the probability of college enrollment (Hemelt & Marcotte, 2011; Meneses & Blanco, 2010). Williamson et al. (2019) estimated that a CP$100,000 increase in tuition (approximately US$140 at the August 2019 exchange rate) is associated with a 5.88% decrease in first-year student enrollment.

## Literature Review

### Short-cycle programs

There is a large body of literature worldwide that examines the relationship between SC programs, usually known in the United States of America as sub-baccalaureate credentials, and students' labor market outcomes after graduation. For this project, I will focus on the effects of graduating from a SC program on labor market outcomes globally, then on the development and recent changes in the higher education context across Latin American countries (LAC), and finally go over the relationship between the distance to or presence of higher education institutions and college enrollment.

A large proportion of the papers on SCPs and labor market outcomes have focused on developed countries like the United States. These papers have shown that SC programs like associate degrees, short- and long-term certificates, can increase their students' likelihood of formal employment and boost wages (Bahr et al., 2015; Belfield & Bailey, 2017; Bettinger & Soliz, 2016; C. Carruthers & Jepsen, 2022; Jepsen et al., 2014; Marcotte, 2019). Similar projects have also found significant heterogeneity in these effects across program fields, with health has consistently documenting the strongest effects (Bahr et al., 2015; Bettinger & Soliz, 2016; C. Carruthers & Jepsen, 2022; Grosz, 2020; Jepsen et al., 2014; Stevens et al., 2019). Conversely,

other studies have reported negative or non-statistically significant for certificates compared to high school graduates or bachelor's degree drop-outs (Belfield, 2015; C. K. Carruthers & Sanford, 2018; Dadgar & Trimble, 2015; Xu et al., 2016).

Across the world, 24 percent of the firms report facing a workforce with inadequate education. This percentage rises to 32 in LAC, the highest among all regions, according to the 2019 World Bank Enterprise Survey. LACs have recently made progress in advancing their higher education programs, increasing enrollment rates from 23 to 52 percent within the last 20 years, although with significant variations between countries (Ferreyra, Díaz, et al., 2022). Ferreyra et al. (2022) find that students SC programs are more likely to belong to the bottom two deciles of the income distribution but are more likely to complete their degrees compared to bachelor's degree students (Ferreyra, 2021; Ferreyra et al., 2017; Sevilla B., 2017). Urzúa (2021) finds that SC graduates have the lowest unemployment rate when compared to all four other education levels, and in most cases, they achieve higher returns than bachelor's degree dropouts.

Like in many Latin American countries, in Chile most of the SC program students come from low-income families (Rodríguez et al., 2016). However, unlike much of Latin America, Chile already has a considerably more developed SC programs system, which enrolls about half of all first-year students. Among the few projects that have tried to estimate the returns that students are able to obtain after graduating from this SCP system, students who narrowly missed the college admissions test cutoff (Prueba de Selección Universitaria or PSU in Spanish) and decided to enroll in an SCP show statistically significant difference in returns compared to those who barely scored above the cutoff (Montoya et al., 2017). Meanwhile, Rodríguez et al. (2016) uses student-level administrative data for all graduates from higher education institutions in Chile in 2008 and a model of unordered schooling decision to estimate the students' unobserved ability. By simulating average annual earnings over a five-year period, they find that graduating from an SC program provides higher returns than high school graduation, although bachelor's degree graduates still achieve even higher returns.

**Distance to Higher Education**

This project also relates to the literature on the effects of geographic distance on students' access to college and their post-secondary education choices. A growing body of literature has

documented the effects of geographic distance on whether students apply to college and where they choose to attend a four-year college in the US (Acton, Cortes, & Morales, 2024; Cortes & Lincove, 2019; Doyle & Skinner, 2016; Fu et al., 2022; Skinner, 2019). This includes studies focusing specifically on students considering attending a community college (equivalent to a THE institution in LAC) in the US (Mountjoy, 2022).

The study of this particular body of literature remains relatively new in developing countries, and particularly across LA countries. Ferreyra et al. (2022) uses the presence of higher education institutions (HEIs) near a student's high school in Colombia as an instrument for local exogenous variation of HE programs to estimate the effects of SCPs on the students' labor outcomes. The authors find that the presence of a HEI increases SCP enrollment by 40-50% of the enrollment rate. Similarly, Katzkowicz et al. (2023) study the effects of building multiple universities in Uruguay and find that decreasing the distance to college increases university enrollment, particularly for less privileged students who are the first among their families to attend HE. However, existing research has not considered the potential heterogeneity of SC programs effects on labor market outcomes across different geographical regions within each country, especially in a country like Chile, where population density is highly concentrated in one area. This paper aims to fill this gap in the literature by studying how the effects of SC programs on labor outcomes vary across regions with high population and HE enrollment concentration. This project will also be relevant for other Latin America countries, such as Argentina and Perú, which face similar geographic concentration of enrollment in a single region.

## Chile's Short-Cycle Higher Education Context

The development of Chile's higher education system began in the 1930s, driven by government efforts to create a workforce capable of meeting the demands of the industrial revolution. In 1965, the expansion of adult education through the Technical and Professional Higher Education System (ESTP) was initiated, with the National Institute for Profesional Training or Instituto Nacional de Capacitación Profesional (INACAP) in Spanish playing a pivotal role in establishing the first technical education centers. By 1968, the system was further strengthened by the Pontificia Universidad Católica de Chile (PUC) with the creation of the Departamento Universitario Obrero Campesino (Duoc UC). However, the 1973 military coup

severely disrupted these developments, leading to the closure of key higher education institutions, including technical schools.

In the 1980s, new educational policies led to the creation of the Technical Training Centers (TTC, known in Chile as Centros de Formación Técnica) and the Professional Institutes (PI, Institutos Profesionales in Spanish) in 1981. TTCs were designated to offer only higher-level technical degrees, while PIs could provide both technical and professional degrees. The 1990s saw a significant expansion of higher education, driven by government support through the Crédito Aval del Estado (CAE). This expansion resulted in the establishment of numerous private institutions, although the number of TTCs and PIs has since declined. The access to Universities in Chile is mostly based on a merit system, where students wishing to attend to a post-secondary education institution typically need to take the national college admission test currently known as the Prueba de Acceso a la Educación Superior (PAES).

Conditional on their scores and preferences, students choose between enrolling in one of the university five-year programs that they have expressed interest in through a list of up to 10 programs they would like to attend, pursuing a two-year or four-year technical degree, or entering the labor market directly. Most five-year university programs set a minimum score for enrollment, admitting students descending order of scores until all the seats are filled. Meanwhile, most of the 2-year and 4-year short-cycle post-secondary programs do not require a minimum PAES score and operate on a first-come first-serve admission system.

The geographic distribution of higher education institutions has begun to diversify gradually. Table 1, using data from CNED, identifies the percentage of campuses by institution type located in each region relative to the nation's total. Between 2005 and 2022, the percentage of campuses in the Metropolitan Region has steadily decreased, suggesting progress in regional diversification. Using the same CNED data, Table 2 presents the share of enrollment spots available across regions. Despite the increase in regional campuses, the distribution of available spots for students remains uneven. Table 2 highlights that while there has been a decrease in the concentration of spots in the Metropolitan Region, a large proportion of TTC and PI enrollment seats are still concentrated in this area. This uneven distribution poses challenges for students outside the Metropolitan Region, who may have fewer options for higher education, underscoring the need for additional efforts to ensure more equitable access across all regions of Chile.

## Research Design

### Data

In order to answer the research questions of this project, I will leverage data from the Social Information Registry (Registro de Información Social in Spanish, from now on RIS). Thanks to the comprehensive set of information gathered in the RIS repository, I will be able to identify all 12th grade high school students belonging from the 2007 cohort until the 2016 cohort across all regions of the country, and will include the students' and their household characteristics, post-secondary enrollment, and post-secondary graduation. Furthermore, the RIS dataset allows the tracking of the students into the labor market providing date of entry into the labor market, wages, general classification of their employment, general classification of the industry of their primary employer, socioeconomic status, and more.

The analytical sample begins with student-level data provided by the Ministry of Education's Academic Performance (*Ministerio de Educación, Rendimiento Escolar*), which includes all school students from 2002 until 2023. From the entire student population in Chile, this project defines its analytical sample as all 12th-grade students between 16 and 20 years old[4] who managed to obtain their diplomas between the year 2007 and 2016, adding up to 1,915,956 students. Table 3 presents the number of students included in the sample by high school graduation year.

These students are then linked to administrative records of from the HE system across all post-secondary institutions, including both SCP focused and universities. The dataset captures all enrollments and graduation at public and private institutions from 2007 until 2021. Focusing only on cases where the students successfully graduated from a program (not necessarily the original they were enrolled in), 625,272 students have valid higher education records, while 1,298,149 students are classified as having only a high school diploma.

In regard to employment and labor data, I will link high school student records to individual monthly earning data from the Unemployment Insurance Fund Administrator (UIFA, Administradora de Fondos de Cesantía in Spanish) from 2008 until 2023. UIFA affiliation is

[4] Students older than 20 years old are considered as adult students by the Ministry of Education, which are not the main focus of this project.

automatic for all workers who are 18 years or older, was hired after April 2nd 2002, and their contract fulfills the Chilean Code of Labor. However the UIFA does not include public employees, people in the armed forces, and independent workers. In the future I will also incorporate earning data from the Superintendency of Pensions (SP, Superintendencia de Pensiones in Spanish) from 2016 until 2023. Unlike UIFA, the SP dataset include public and independent workers, providing a more comprehensive representation of the Chilean labor market.

Additionally, I will also integrate the Annual National Industrial Survey (ENIA in Spanish), an annual census of all manufacturing firms with 10 workers or more, which contains detailed information of the firm's employment demand. Including the ENIA dataset will allow me to account for local employment demand and local labor markets conditions.

Moreover, I will complement these administrative datasets by including household- and county-level data sources: household characteristics from the Social Protection Survey (SPS, Ficha de Protección Social in Spanish), covering 2006 to 2015, and the Household Social Registry (HSR, Registro Social de Hogares in Spanish), covering 2016 to 2023. Additionally, I will incorporate county-level characteristics from the National Socioeconomic Characterization survey (CASEN, Encuesta de Caracterización Socioeconómica Nacional).

One main limitation regarding my current dataset is that household characteristics data is unavailable for majority of the sample. In the earlier sample years, the SPS contained records for approximately 44% of the sample. To my knowledge, no study has examined which groups of students were more or less likely to be surveyed, making it extremely difficult to ascertain the potential direction of bias introduced if I were to consider only the portion of students with full household data. Meanwhile, county-level characteristics data is available for the years 2000, 2003, 2006, 2009, 2011, 2013, 2015, 2017, and 2022, and also for a subset of all counties in the country. After reviewing all data available, the CASEN survey covers at least 75% of all counties in each surveyed year, making it a viable option. Since not all the sample years are included in the survey, I will use the most recent year available before each student's high school graduation years.

Fortunately, the dataset overcomes several limitations found in similar studies, such as Mountjoy (2022) and Ferreyra et al. (2022). In Mountjoy's (2022) study, which focused on students from Texas, the dataset did not include college enrollment or earnings from students

who left the state. My dataset avoids this issue as it includes all high school students and tracks their college enrollment nationwide, allowing me to analyze the heterogeneity of labor market returns across Chilean regions. Similarly, while Ferreyra et al. (2022) observed college students in Colombia, but was not able to include students' labor market data for those who did not enrolled in a higher education program, did enrolled in higher education but dropped out, or were still enrolled in a higher education program by the year 2013. My dataset includes all non-public and dependent workers in Chile, regardless of whether they graduated from a higher education program.

**Methods**

To causally estimate the effects that graduating from a SCP has on their graduate's labor market outcomes, I cannot rely on OLS estimates as they are not able to account for the high school graduate's self-selection into a particular post-secondary option. To overcome the self-selection problem related with estimating the effects of students' post-secondary choices on their labor market outcomes, in this project I use an Instrumental Variable (IV) approach. The instruments are the proximity of each students' high school to a SC program focused institutions ($Z_i$), and the assumption is that it affects the treatment of graduating from a SCP but does not affect the outcomes variable directly. In a setting with only one margin of treatment, using an IV model would allow for the identification of the local average treatment effect (LATE) among compliers (Imbens & Angrist, 1994). In the context of this project, students always have at least 3 different choices after they graduate from high school (joining the labor market, THEI, and university), which results in multiple treatment margins. The multiple treatment margins means that a standard IV method would provide the effect of graduating from a SCP relative to the mix of the students' two other treatment margins.

Mountjoy (2022) developed a new IV approach which takes advantage of rich student longitudinal data and the exogenous variation of local higher education institutions (HEI) supply. By including not only an instrument for the presence of THEI, but also for universities, nearby students' high schools, this new approach manages to estimate the proportion of students whose next best choice to SCP was immediately joining the labor market (expansion margin) or

enrolling into a university (diversion margin), while also providing causal estimates of SCPs on labor market outcomes.

Taking this model's setting and the context of Chilean students' educational choices, students will fall into 4 relevant groups to this paper. These group of students are based on the treatment of enrolling and graduating from a SC program and I will attempt to use the construction of new SC focused campuses as an external variation on students costs of enrollment into college.

i. Never Takers: These are students who will never choose to enroll into a SCP and were always going to enroll into either a type-B college or not enroll in any post-secondary program and go immediately into the labor market.
ii. Always Takers: Students that were always going to enroll in a SCP-focused institution, no matter if there was a type-B college closer or if there was no type-A college anywhere near close to where the student lived while attending high school. Students may choose this option because the psychological costs of enrolling into a type-B college are far too high for them, or they cannot afford the type-B college tuition costs, but students still see the benefits of a post-secondary education.
iii. Expansion Margin: These are students who are on the margin between not enrolling into any post-secondary program and going into the labor market or enrolling into a SCP. So, these students would not enroll in higher education if a new SCP-focused campus was not built nearby.
iv. Diversion Margin: Students who are on the margin of enrolling into a type-B college program or into a type-A SCP. Similar to the expansion margin group, these students will probably enroll into a type-B college if a new type-A college was not built nearby.

One last potential group of students could be, although very unlikely, students who are on the margin between not enrolling into higher education or enrolling in a type-B college. In either choice, these students would never be affected by the construction of a new type-A campus, falling into the never taker group. The model focuses on 2 different types of equilibrium based mostly on transportation costs. The first is for students who are choosing between no post-secondary education or technical education (Expansion margin), while the second are the students who are choosing between a type-A college or type-B college program.

Following the literature, this identification strategy relies in three assumptions. First, I assume that conditional on students' background and other controlling characteristics, whether

there exists a HEI institution nearby the students' high school is uncorrelated with the students' future labor market outcomes. Secondly, the instrument must only affect the outcome through its impact on the treatment, and not directly. Finally, I assume that the instrument follows the partial monotonicity restriction (Mogstad et al., 2021; Mountjoy, 2022), which requires that every student should never be less likely to attend a THEI institution if there is one nearby his or her high school, and regardless of any other HEI that may be in the vicinity.

To identify the exogenous variation in local higher education supply, I utilize CNED data which identifies the geographic locations of all the HEI that where operational at any point between 2002 and 2023. I then use geographic location of high schools, provided by the Ministry of Education's Open data[5], to construct the two main instruments $Z_{ij}$ and $H_{ij}$, where i denotes the student and j denotes the high school that student i graduated from.

$Z_{ij}$ will equal 1 if at least one SCP-focused institution is within 10 kilometers (km) of high school j, and 0 otherwise. Similarly, $H_{ij}$ will equal 1 if at least 1 university institution is within 10 km of high school j, and 0 otherwise. A preliminary reviews of the data show that an 85.61% of students in the sample graduated from a high school that was within 10km of a SCP-focused college, while this share dropping to 80.73% for universities.

Assuming ideal conditions and access to a dataset containing individual-, household-, and county-level characteristics, I will estimate the impact of graduating from an SCP-focused college using $Z_{ij}$ and $H_{ij}$ as the main instruments in both the first and second stage (Ferreyra et al., 2022; Mogstad et al., 2021; Mountjoy, 2022). The first stage equation is:

$$D_{ijk}^{SC} = \gamma_0^{SC} + \gamma_1^{SC} Z_{ij} + \gamma_2^{SC} H_{ij} + \gamma_x^{SC} X_{ik} + \epsilon_{ijk} \qquad (1)$$

Where $D_{ijk}^{SC}$ will equal 1 if student i, who graduated from high school j and lived in county k, enrolled in an SCP-focused college and graduate from an SC program. $X_{ik}$ is a vector that includes student- and household-level characteristics like gender, age, whether the student attended a rural serving high school, 12$^{th}$-grade GPA, average attendance rate, special needs status for school participation, household's highest level of education, and household income. Additionally, the vector includes county-level characteristics such as the percentage of the

[5] https://datosabiertos.mineduc.cl/

county's population living in rural areas, total population size, and other relevant factors. All variables from vector $X_{ik}$ are measured before each student graduated from high school. With this notation in mind, the second stage (outcome) equation is:

$$Y_{ijkt} = \beta_0 + \beta_{SC} D_{ijk}^{SC} + \beta_H H_{ij} + \beta_X X_{ik} + u_{ijkt} \qquad (2)$$

Where $Y_{ijkt}$ represents the labor market outcome at year t for student i, who graduated from high school j and lived in county k. This project focuses in five main labor market outcomes. The first is the probability of working in the formal sector, defined as whether student i is included in the UIFA. The second is the level of formality during year t, defined as the number of months (out of those available) that student i worked in a job reported in the UIFA. The third outcome is average monthly wages, calculated as the sum of wages obtained during year t divided by the number of months worked in that year. The fourth and fifth outcomes measure the average monthly wages earned during the first and fifth years in the labor market, respectively. All average monthly wage outcomes are calculated from the year that student i completes their education, whether immediately after high school or following graduation from college (either SC or university).

There are two major threats to these assumptions. The first is the possibility that HEIs endogenously decide where to open their campuses, particularly if they tend to locate primarily in large municipalities. If this were the case, the treatment variation might be driven more by living in a large city than by the actual presence of an HEI nearby. To address this concern, I will utilize the ENIA company survey to analyze location patterns between businesses and HEI campuses.

Additionally, I will utilize detailed reports on the decision of campus locations from the two largest SCP-focused institutions in Chile, allowing me to map the relevant factors considered in the campus location choices. Using this information, I will find cities with similar factors and no HEI institutions in the vicinity to use as controls and run the main model specification for this subset of observation. If the estimated coefficients are statistically similar to those obtained from the main sample, I can reasonably conclude that this threat does not pose a major issue.

A second potential threat to the identification strategy arises if families deliberately choose to live closer to the nearest college. I will address this concern in two ways. First, I have created an

indicator which will confirm that students remained in the same high school throughout 9th, 10th, 11th, and 12th grade. According to this indicator, 1,704,062 students (88.94%) did not change high schools during these four years. This high percentage reduces concerns about families endogenously selecting their place of residence based on proximity to a college.

However, to ensure that the main results remain robust, I will estimate the preferred model using only the sample of students who did not transfer between high schools or counties. If student movement is not driven by families choosing where to live based on college locations, the estimates between the initial sample and the non-mover subgroup should be similar.

Furthermore, instead of using binary indicator that equal 1 if a student's high school is within a 10-km radius from at least one THEI or university, I will implement a recently developed measure of post-secondary opportunity exposure from Flanagan and Doyle (2024). This metric is a weighted average distance from a student's high school to all HEIs in the country, which I will calculate separately for THEIs and universities. By incorporating all institutions nationwide, this measure mitigates potential bias from families based solely on proximity to a single nearby college. While some families may be aware of the nearest college, it is far less likely to know the second or third nearest institution. Additionally, this measure not only accounts for the presence of at least one HEI nearby but also accounts for the number of HEIs within proximity and their relative accessibility. It is reasonable to assume that students attending high schools near a greater concentration of HEIs will have a greater exposure to higher education opportunities.

To create this measurement of college access exposure, first I will create a matrix with the distance between each high school and each HEI in Chile. With this matrix, the weights assigned to each HEI for each high school are defined as the inverse distance

$$w(j,g) = \frac{1}{d(L(j),L(g))^{p}} \qquad (3)$$

Where $L(j)$ is the location of high school j, $L(g)$ is the location of HEI g, $d\big(L(j),L(g)\big)$ is the Vicenty distance[6] between high school j and HEI g, and p is a decay function that, when increased, further reduces the weights of distant institutions. Using these weights, I can compute an average of what Flanagan and Doyle (2024) refer to as "opportunity measures", which include

[6] The Vicenty distance measure the distance between two points in an elliptical sphere. Flanagan and Doyle (2024) suggest this is an appropriate measure to calculate distances between two points while accounting for the curvature of the earth.

tuition and enrollment. For this project, I will focus on vacancy instead, which represents the number of seats available for first-year enrollment at each college, instead of enrollment as I believe it better reflects the resources available at each institution. The average-weighted opportunity measures for high school j is defined by:

$$\tilde{x_j} = \sum_{g=1}^{G} \frac{x_g}{w(j,g)} \qquad (4)$$

Where $x_g$ is the corresponding opportunity measure for HEI g, and $w(j,g)$ the weight of HEI g for high school j. This measure not only avoids the limitations of political or administrative boundaries but, more importantly for this project, goes beyond simply identifying whether at least one HEI is nearby. It accounts for the number of HEIs nearby as well as their capacity to admit students. I will use a separate version of these average-weighted measure for SCP-focused institutions and universities separately as an updated version of the proximity instruments used in Equation (1). The model using this new measure of college access exposure will be:

$$D_{ijk}^{SC} = \gamma_0^{SC} + \gamma_1^{SC} \tilde{x}^{SC}{}_{ij} + \gamma_2^{SC} \tilde{x}^{H}{}_{ij} + \gamma_x^{SC} X_{ik} + \epsilon_{ijk} \qquad (5)$$

$$Y_{ijkt} = \beta_0 + \beta_{SC} D_{ijk}^{SC} + \beta_H \tilde{x}^{H}{}_{ij} + \beta_X X_{ik} + u_{ijkt} \qquad (6)$$

Where $\tilde{x}^{SC}{}_{ij}$ is the SCP focused weighted-average opportunity access for student i and high school j, and $\tilde{x}^{U}{}_{ij}$ is the university focused weighted-average opportunity access for student i and high school j.

**Heterogenous effects by Region**

One of the main contributions of this paper will is its examination of the possibility that labor market outcomes vary across regions, particularly in a country where a large share of the population is concentrated in a single area. To address this, I will first estimate a model similar to the one described in Equations (1) and (2), incorporating categorical variables for Chile's different regions in the second stage:

$$Y_{ijkt} = \beta_0 + \sum_{h=1}^{16} R_h \beta_{SC} D_{ijk}^{SC} + \beta_H H_{ij} + \beta_X X_{ik} + u_{ijkt} \qquad (7)$$

Where $R_h$ equals 1 if student i attending high school j in region h during their final year. By setting the Metropolitan Region, where the capital of Santiago is located, as the base category, I can examine how residing in region h and graduating from an SCP affects labor market outcomes across the country. I will also estimate this revised model using Flanagan and Doyle (2024) weighted-average opportunity exposure measure to account for the proximity of multiple HEIs, using the following model:

$$Y_{ijkt} = \beta_0 + \sum_{h=1}^{16} R_h \beta_{SC} \tilde{x}^{SC}{}_{ij} + \beta_H \tilde{x}^{H}{}_{ij} + \beta_X X_{ik} + u_{ijkt} \qquad (8)$$

**Low sample coverage of household data**

After reviewing the available household characteristics data, I found that for the earlier years of the sample, the SPS survey covered only about 44% of the sample. This rate of coverage does improves with the HSR survey, reaching an approximate coverage of 70% of the sample between 2016 and 2023.

If I were to include observations with valid data for all variables considered in Equation (1), the estimation results would be highly biased in an unknown direction, as I am unable to calculate the probability of each student being surveyed.

In hopes to overcome this data limitation, I will adapt the model describe in Equation (1) by incorporating individual fixed effects and individual time trends. Individual fixed effects will account for all unobserved individual characteristics, under the assumption that they do not vary over time, that could potentially affect the probability of enrolling and graduating from a SCP. Meanwhile, individual time trends will control for time-invariant individual characteristics that may explain part of the individual differences in wages and wage growth trends in my dataset (Dynarski et al., 2018; Jacobson et al., 2005; Meyer et al., 2022). The model including both individual fixed effects and individual time trends is:

$$D_{ijk}^{SC} = \alpha_i + \omega_i t + \gamma_0^{SC} + \gamma_1^{SC} Z_{ij} + \gamma_2^{SC} H_{ij} + \gamma_x^{SC} X_{ik} + \epsilon_{ijk} \qquad (9)$$

$$Y_{ijkt} = \alpha_i + \omega_i t + \beta_0 + \beta_{SC} D_{ijk}^{SC} + \beta_H H_{ij} + \beta_X X_{ik} + u_{ijkt} \qquad (10)$$

Equations (9) and (10) represent the first and second stages respectively, where $\alpha_i$ represents the individual fixed effects holding constant the students' time-invariant characteristics, and $\omega_i t$

are the individual time trends. In order to test the level of sensitivity of my results to the inclusion of household characteristics, I will estimate the individual fixed effects version of the model using only the subsample of students with valid data for all household-level variables. If the individual fixed effects model is actually able to account for most of the unobserved factors affecting the enrollment and graduation from a SCP, then I expect for these two models to provide similar results.

**Radii definition**

Another potential concern with the original proximity instrument used in Equations (1) and (7) is the potentially arbitrary 10-km length of the radius. The composition of students included in the close to a HEI category could vary with smaller or larger radii. To assess the sensitivity of the results obtained with the 10-km radius, I will estimate a similar model describe in Equations (1) and (7) using the same sample but applying different radii, and compare the results. If the results are in fact robust, the estimated effect should not change significantly in magnitude while maintaining the same level of statistical significance.

## Conclusion

Short-cycle programs (SCPs) can equip individuals with skills that are highly demanded by the labor market within a short timeframe and have the potential to strengthen local labor markets by helping them adapt to technological and economic changes. This study will provide causal evidence on the impact of SCP graduation on labor market outcomes and explore the potential variation in these effects across the regions of a country with a disproportionate population and college concentrations. Using a comprehensive, nationwide longitudinal student dataset, the study will identify the proportion of students whose next-best alternative to choosing an SCP would have been either direct entry into the labor market (expansion margin) or enrollment in a university program (diversion margin), along with the impact of SCPs on labor market outcomes at both national and across regions. The Local Average Treatment Effect (LATE) estimates from the Instrumental Variable (IV) model will provide insights into outcomes

for students who graduated from an SCP and were influenced to enroll by their exposure to college access opportunities.

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# Appendix

## Tables

Table 1 – Distribution of Campuses by Institution Type: 2005, 2010, 2015, and 2022

| | | | 2005 | | | 2010 | | | 2015 | | | 2022 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TTC | PI | Univ | TTC | PI | Univ | TTC | PI | Univ | TTC | PI | Univ |
| Far North | 15 | Región de Arica y Parinacota | 2.34 | 1.69 | 2.52 | 2.17 | 1.46 | 2.55 | 2.80 | 1.33 | 2.63 | 3.74 | 1.61 | 2.61 |
| | 1 | Región de Tarapacá | 1.56 | 1.69 | 2.52 | 1.45 | 1.46 | 3.57 | 2.80 | 1.33 | 3.16 | 2.80 | 1.61 | 3.27 |
| | 2 | Región de Antofagasta | 3.13 | 5.93 | 5.66 | 3.62 | 5.84 | 7.65 | 7.48 | 5.33 | 7.37 | 4.67 | 4.84 | 5.23 |
| Near North | 3 | Región de Atacama | 1.56 | 1.69 | 1.89 | 2.90 | 2.19 | 3.06 | 4.67 | 2.00 | 4.21 | 2.80 | 2.42 | 1.96 |
| | 4 | Región de Coquimbo | 7.81 | 5.93 | 5.03 | 7.97 | 5.84 | 5.61 | 5.61 | 6.00 | 5.79 | 12.15 | 5.65 | 5.88 |
| Central Chile | 5 | Región de Valparaíso | 15.63 | 10.17 | 16.35 | 13.04 | 13.14 | 12.76 | 12.15 | 15.33 | 12.11 | 13.08 | 13.71 | 12.42 |
| | **13** | **Región Metropolitana** | **34.38** | **29.66** | **26.42** | **28.99** | **26.28** | **21.94** | **22.43** | **25.33** | **23.16** | **15.89** | **21.77** | **24.18** |
| | 6 | Región del Gral. B. O'Higgins | 3.91 | 4.24 | 2.52 | 1.45 | 6.57 | 4.08 | 3.74 | 6.00 | 4.21 | 4.67 | 7.26 | 3.92 |
| | 7 | Región del Maule | 5.47 | 6.78 | 6.29 | 8.70 | 8.03 | 6.63 | 11.21 | 8.00 | 6.32 | 9.35 | 8.06 | 6.54 |
| | 16 | Región de Ñuble | 3.13 | 4.24 | 3.77 | 2.17 | 5.11 | 4.08 | 1.87 | 4.00 | 4.74 | 1.87 | 4.03 | 4.58 |
| | 8 | Región del Bío-Bío | 9.38 | 16.10 | 13.84 | 10.14 | 13.87 | 12.76 | 8.41 | 13.33 | 12.11 | 10.28 | 15.32 | 11.76 |
| South | 9 | Región de La Araucanía | 5.47 | 2.54 | 5.66 | 5.80 | 4.38 | 5.61 | 8.41 | 5.33 | 5.26 | 6.54 | 5.65 | 6.54 |
| | 10 | Región de Los Lagos | 6.25 | 7.63 | 5.66 | 7.25 | 6.57 | 8.16 | 5.61 | 6.67 | 6.84 | 5.61 | 8.06 | 7.84 |
| | 14 | Región de los Ríos | 1.56 | 2.54 | 1.26 | 2.90 | 2.19 | 2.55 | 2.80 | 2.67 | 2.63 | 5.61 | 4.03 | 2.61 |
| Austral | 11 | Región de Aysén | 0.78 | 0.85 | 0.63 | 1.45 | 1.46 | 0.51 | 1.87 | 1.33 | 1.58 | 2.80 | 1.61 | 2.61 |
| | 12 | Región de Magallanes | 1.56 | 2.54 | 2.52 | 1.45 | 2.19 | 2.55 | 1.87 | 2.00 | 2.11 | 2.80 | 1.61 | 1.96 |

Notes: TTC (Technical Training Center), PI (Profesional Institute), Univ (University). Source: CNED institutional records between 2005 and 2022.

Table 2 – Distribution of Enrollment Seats in Campuses by Institution Type: 2005, 2010, 2015, and 2022

| | | | 2005 | | | 2010 | | | 2015 | | | 2022 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TTC | PI | Univ | TTC | PI | Univ | TTC | PI | Univ | TTC | PI | Univ |
| Far North | 15 | Región de Arica y Parinacota | 1.30 | 0.42 | 1.78 | 1.21 | 0.29 | 1.78 | 2.99 | 0.33 | 1.44 | 2.75 | 0.32 | 1.34 |
| | 1 | Región de Tarapacá | 1.11 | 0.86 | 2.12 | 1.61 | 0.51 | 2.86 | 1.97 | 0.67 | 2.53 | 2.94 | 0.74 | 1.51 |
| | 2 | Región de Antofagasta | 2.55 | 3.15 | 3.21 | 3.22 | 2.91 | 3.66 | 3.74 | 2.97 | 4.59 | 3.87 | 2.80 | 2.52 |
| Near North | 3 | Región de Atacama | 1.70 | 0.80 | 0.84 | 1.71 | 1.15 | 1.06 | 1.66 | 0.54 | 1.21 | 1.53 | 0.75 | 0.83 |
| | 4 | Región de Coquimbo | 5.72 | 3.17 | 3.50 | 4.75 | 3.90 | 3.62 | 5.24 | 3.51 | 4.35 | 7.70 | 2.52 | 3.00 |
| Central Chile | 5 | Región de Valparaíso | 10.72 | 9.01 | 15.33 | 11.18 | 9.75 | 14.23 | 8.08 | 11.10 | 12.68 | 9.65 | 7.60 | 11.60 |
| | **13** | **Región Metropolitana** | **48.02** | **58.51** | **44.66** | **45.10** | **48.96** | **43.25** | **39.07** | **49.43** | **46.23** | **30.94** | **62.95** | **49.56** |
| | 6 | Región del Gral. B. OHiggins | 2.99 | 3.45 | 0.58 | 2.59 | 4.73 | 0.90 | 2.85 | 5.63 | 1.13 | 3.78 | 3.33 | 1.04 |
| | 7 | Región del Maule | 5.06 | 2.77 | 4.52 | 6.33 | 4.18 | 3.82 | 8.20 | 3.65 | 3.18 | 10.33 | 2.51 | 4.14 |
| | 16 | Región de Ñuble | 1.77 | 1.80 | 2.49 | 2.13 | 2.69 | 1.87 | 2.93 | 1.94 | 2.41 | 2.53 | 1.62 | 1.83 |
| | 8 | Región del Bío-Bío | 7.80 | 10.39 | 10.78 | 7.80 | 12.51 | 12.01 | 7.84 | 11.15 | 10.26 | 8.70 | 8.28 | 11.02 |
| South | 9 | Región de La Araucanía | 4.95 | 1.27 | 4.93 | 4.90 | 3.06 | 4.11 | 6.11 | 3.56 | 4.11 | 5.74 | 2.30 | 4.51 |
| | 10 | Región de Los Lagos | 3.92 | 2.98 | 2.15 | 4.41 | 3.84 | 3.36 | 5.18 | 4.41 | 2.48 | 4.54 | 3.29 | 3.75 |
| | 14 | Región de los Ríos | 0.79 | 0.81 | 1.71 | 1.29 | 0.64 | 2.36 | 1.68 | 0.78 | 2.37 | 2.74 | 0.73 | 2.35 |
| Austral | 11 | Región de Aysén | 0.65 | 0.11 | 0.00 | 0.74 | 0.39 | 0.05 | 0.93 | 0.02 | 0.23 | 0.67 | 0.07 | 0.34 |
| | 12 | Región de Magallanes | 0.95 | 0.53 | 1.41 | 1.03 | 0.48 | 1.07 | 1.54 | 0.32 | 0.81 | 1.59 | 0.17 | 0.65 |

Notes: TTC (Technical Training Center), PI (Profesional Institute), Univ (University). Source: CNED institutional records between 2005 and 2022.

Table 3 – Distribution of Students included in the Analytic Sample by Year of High School Graduation

| Year | Grad HS Stud |
|---|---|
| 2007 | 182,374 |
| 2008 | 200,654 |
| 2009 | 200,565 |
| 2010 | 199,906 |
| 2011 | 193,223 |
| 2012 | 190,615 |
| 2013 | 188,502 |
| 2014 | 186,579 |
| 2015 | 188,349 |
| 2016 | 185,189 |
| Total | 1,915,956 |

Note: Created using data from the Ministry of Education, Academic Performance. Includes stundents who graduated from HS and were between 16 and 20 years old at the moment of graduation.