The Rural-Urban Divide in Transitions to Higher Education in Chile

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Abstract: *This study uses administrative student data from Chile to explore the transitions of urban and rural students to higher education. We find that urban students are more likely to register to take university entrance exams than rural students. Among those who do take the exams, urban students perform significantly better. Even though both groups of students enroll in higher education in similar proportions, urban students are more likely to enroll in universities, whereas rural students are more likely to enroll in technical education. We also explore differences in major choices for students who enroll in higher education and find that rural students are more likely to enroll in fields related to health, education, and agriculture, while they are less likely to enroll in social sciences or the humanities. Finally, both groups are as likely to choose STEM fields when enrolling in higher education. Our findings suggest that although rural students have similar access to higher education as their urban counterparts, they face different challenges, especially related to standardized tests, which have an impact when choosing which type of higher education institution to enroll in.*

Keywords: *STEM; rural; urban; gap; college major-choice; achievement; higher education*

Introduction

Rural students face unique difficulties in their transition to higher education for several reasons, including the resources they typically have access to, their collective histories, and, in many cases, the preparation they receive in high school (Scott et al., 2016, p.1). Data from the Programme for International Student Assessment (PISA) in the years 2015 and 2018 show that, on average across OECD countries, students in city schools score approximately 30 points higher in science than students in rural schools, which is roughly equivalent to one additional year of schooling (Echazarra & Radinger, 2019). Results from PISA 2022 reflect the same types of gaps between urban and rural schools at different schooling levels (OECD, 2023).

Understanding the pathways towards higher education is relevant in the context of rural development when we consider that there are positive returns to higher education, not only in terms of income but also in skills and capabilities (Oreopoulos & Petronijevic, 2013). This study focuses on the transitions of rural and urban students to higher education in the context of Chile, a developing country.

Previous research has shown that rural high school students are less likely than their urban counterparts to enroll in postsecondary institutions, particularly four-year colleges (Yan, 2002; Hu, 2003; Sparks & Nuñez, 2014). By comparing rural high school graduates with their urban and suburban peers, Byun et al. (2012) show that rural students were less likely to enroll in selective universities. In addition, compared to their urban counterparts, graduates of rural high schools were more inclined to delay the start of postsecondary education. Furthermore, rural high school graduates who attended college were less likely to maintain enrollment over time. Studies focusing

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on the STEM (Science, Technology, Engineering and Mathematics) pathways between rural and urban students when entering high school show that rural and urban students' interest in STEM careers is comparable, but by the conclusion of the 11th grade, rural students' enthusiasm has decreased significantly (Saw & Agger, 2021).

In line with this literature, we examine data from Chile to explore the existence of an urban-rural divide in the transition to higher education. For this, we use administrative data from the Chilean Ministry of Education, which includes every student who graduated from high school between 2014 and 2017, to examine the differences between urban and rural students in their transition to higher education. We combine this data with data from college applications, enabling us to determine the type of institution and major that each student ultimately chose to enroll in. We then estimate logistic regressions for each transition, while controlling for a series of observable characteristics.

In the first transition, we find that rural students are less likely to register for university entrance exams. When looking at those who take the exams, we find that rural and urban student are as likely to enroll in higher education, but rural students do so proportionally more in technical institutions and less in universities. In terms of fields of study, rural students focus more on applied fields, such as agronomy, health, and engineering, and less on fields related to social sciences and humanities than urban students. Finally, we find that rural students are also less likely to enroll in STEM fields.

Literature Review

Higher education is essential to economic and social development. Institutions of higher education are primarily responsible for providing individuals with the advanced knowledge and skills necessary for positions of responsibility in government, business, and other professions (Gale & Parker, 2014). Although more students in developing countries have achieved access to higher education over time, several studies have shown that there are still disparities in access between rural and urban students. According to data from PISA 2015 and TALIS 2013, on average across OECD countries, about half of the students in urban schools are expected to complete a university degree; this percentage goes down to 30% for students in rural schools (Echazarra & Radinger, 2019).

While a broader literature has explored transitions to higher education, in this paper we focus on the comparison between urban and rural students during the different stages of the transition process. Empirical studies in developed countries have shown that rural students experience lower rates of college enrollment and degree completion than their non-rural peers (Scott et al., 2016; Wells et al., 2019). Hu (2003) investigates students' postsecondary access and choice, as well as their educational aspirations, using data from the National Education Longitudinal Study of 1988 (NELS) of the United States. The results show that higher percentages of students in rural schools desired to attend high school (16.6% for rural in contrast to 11.0% for urban and 10.6% for suburban schools). Another major finding is that the percentage of students enrolling in four-year colleges was comparatively higher in urban schools (60.8%) compared to suburban schools (56.9%) and rural schools (56.4%). Byun et al. (2017, p.1) study patterns of college attendance using data from a nationwide and contemporary sample of rural youth in the United States. The authors found that more than half of the rural youth attended two-year institutions at some point during their college career and about a fourth initially enrolled in a two-year college before enrolling in a four-year college. Means et al. (2016) examine the college choice process, barriers and career aspirations of African American high school students from rural schools. This study explores qualitatively the importance of emotional support provided by teachers and families within the context of career aspirations and college preparedness.

Fleming and Grace (2017), using data from regional and rural students provided by the government of Australia find that there is an increase in higher education attainment intention, especially in year 10 students, and also explore the unique factors that affect the transition into higher education for rural students. Also in Australia, Gao et al.(2022) explore the stalled growth in rural student participation in higher education and focus on the importance of developing context-specific local programs for students. Lasselle (2016) explored access to higher education in Scottish rural communities. The author shows that rural students perceive a higher barrier regarding the financial and geographical challenges they face, compared to urban students.

While the gender gap in access to STEM fields has been more widely documented (Riegle-Crumb et. al, 2011; Tandrayen-Ragoobur & Gokulsing, 2021; Herskovic & Silva, 2022), not much is known about the differences between urban and rural student's enrollment in these fields. Li et al. (2007) and Hango et al. (2021, p.1) examine the possible interaction effects of gender and region— (urban vs. rural) on student beliefs about women in math and science. They suggest that urban students, regardless of their gender, were more likely to consider careers related to science or mathematics than rural students. Along similar lines, Saw & Agger (2021) used the United States nationally representative High School Longitudinal Study of 2009 to document that rural and small-town students were significantly less likely to enroll in postsecondary STEM degree programs compared to their suburban peers. The results indicate that a rural–suburban gap in STEM career aspirations emerged by the end of 11th grade (8.9% rural vs. 10.5% suburban).

Relatively few studies have focused on transitions into higher education in the context of Chile. Gallego et al. (2007) analyzed the optimality of institutionality in public education in rural areas to efficiently reach a minimum level of educational quality. The results on educational quality show that students who attend rural schools have lower standardized test scores than urban students (0.35 standard deviations). This suggests that students in rural areas are not receiving the same quality of education as students in urban areas, which could put them at a disadvantage when it comes to transitioning to higher education.

In Sevilla -Encinas (2018), the focus is on how social background influences access to the higher education system in Chile. The research explores the impact of prior academic performance and parental education and expectations on these differences. The findings reveal that in selective educational paths, achievement gaps play a significant role in explaining enrollment disparities between income quintiles. However, in non-selective tracks, social background emerges as a key determinant of educational outcomes, more so than academic achievement. The author finds that students from lower socioeconomic backgrounds continue to be underrepresented in higher education.

Contreras et al. (2023) analyzed how the COVID-19 pandemic has affected Chilean students with disabilities as they advance to higher education. The authors find while attendance rates for elementary and secondary education are comparable for students with and without disabilities, transitioning to postsecondary education is 15.7% less likely for students with disabilities. Additionally, the findings demonstrate that the gap has grown since the pandemic. This suggests that the COVID-19 pandemic has had a disproportionate impact on students with disabilities, making it more difficult for them to transition to higher education.

Overall, these studies suggest that there are a number of factors that can affect a student's transition to higher education in Chile, including social origin, academic achievement, and disability status. These factors can make it more difficult for students to access higher education, and they can also affect their success once they are enrolled. At the same time, the international and Chilean-focused literature lacks empirical studies examining the comparison between urban and rural students' transitions to higher education in a country as a whole, considering all students in the system, and all possible stages in these transitions. Studies so far have focused either on smaller groups or sub-populations or on specific stages in the transition process. This necessarily generates limitations on the ability of the authors to generalize from their findings.

This study contributes to bridging this gap in the literature on access to higher education by rural students in developing countries by exploring all key sequential transitions into higher education, from high school graduation to choice of STEM field, with all stages in between. As a distinguishing characteristic of this study, we follow all students in high school in Chile over three cohorts, as they progress towards higher education, which allows us to examine the behavior of the complete population of urban and rural students, controlling for their characteristics and performance. Even though we do not make claims of causality, this allows us to better isolate the effect of living in rural areas as this relates to transitions to higher education. The results expand those from previous studies focused on Australia, South Africa, China, and India, contributing to a more extensive understanding of the issues faced by rural students in developing countries (Fleming & Grace, 2014; Chakrabarti, 2009; Mgqwashu et al, 2020; Yang, 2010). Specifically, we investigated the stages that potentially guide students from high school to higher education institutions, ultimately shaping their career paths in STEM fields. Notably, our research addresses a significant gap in the literature, as a small proportion of previous studies have examined the specific barriers encountered by rural students in this context when accessing higher education. By shedding light on these challenges, our study offers insights into the unique hurdles faced by rural students during their educational journey in developing countries, facilitating a more comprehensive understanding of the factors influencing their access to higher education and their subsequent pursuit of STEM careers.

Rural Education in Chile

Increasing the national coverage of education was one of Chile's main challenges in the 1990s (Arellano, 2001). This explains the spike in educational policy initiatives to promote the integration of boys and girls with special needs into mainstream schools and address the associated problems. In this period, attention is focused on the design of educational policies and strategies that promote the generation of conditions that facilitate the integration of students with disabilities into regular school. This is how a few years later Chile adopted the School Integration Program (PIE), an inclusive educational strategy that aims to support all students, especially those with permanent or temporary special education needs (SEN) in meeting their learning objectives and participating in class (Tamayo Rozas et al, 2017 and 2018). This approach also intends to help educational establishments maintain a high standard of instruction. Within this context, in 1992, the Program to Improve the Quality and Equity of Education for Rural Basic Schools (MECE RURAL) was implemented. The objective of this program was to move towards differentiated education in inputs, school management processes and pedagogical practices, for children and young people in rural schools and to offer rural students equal opportunities based on results (MINEDUC, 2000).

In 2021, according to Chile's National Institute of Statistics (INE), 13.4% of the population was considered rural and 86.6% was considered urban. The results from a large household survey Encuesta de Caracterización Socioeconómica Nacional (CASEN) in the year 2020, showed that poverty is more prevalent in rural regions (13.82%) than in urban areas (10.42%). Rural poverty, however, declined significantly in the previous three years (from 16.5% in 2017), whereas urban poverty increased (from 7.4% in 2017). While enrollment in the education system has decreased in recent years, this decrease has been more prominent in rural establishments, mainly driven by the drop in rural primary education enrollment. This reduction was more than five times greater than that experienced by the educational system as a whole (5.1%). This asymmetry can be explained by the lower population in rural areas and greater connectivity to travel to urban establishments (Zamorano et al., 2017). According to the Ministry of Education (MINEDUC) in the year 2021, there were 3,317 rural schools and high schools in Chile, 53.8% of which were concentrated in the most isolated areas of the country. Rural educational establishments comprised 54% public schools and 46% private or subsidized schools (Zamorano et al., 2017). At younger ages, some rural schools are organized as multigrade classrooms, which respond to the diversity of students who attend, given their age, learning dispositions, and starting points. In a multigrade school, at least one of its classrooms is combined, that is, it is made up of students from different grades (MINEDUC, 2024). Multigrade schools constitute a significant pedagogical problem because they host students of varying ages and courses in one classroom with a single teacher. Boys and girls from rural areas may not be able to achieve the same level of success because the majority of their teachers have been educated to teach one-on-one courses and identical classes to every student (Fundación 99, 2023, p.1). When looking at standardized test scores taken both during the 4th grade and during the process of higher education admissions, students from urban schools consistently outperform rural students. On both tests, urban students outperformed rural students in mathematics, language, and reading comprehension (Licsa, 2016).

All students who graduate from high school may choose to register and take a university entrance exam (PSU) that is required for admission at selective universities but is not required for other types of higher education institutions, such as technical or professional institutes. Quiroz et. al (2022) uses a Heckman probit-type (Heckit) model to adjust for selection during application to higher education. The results show that just 37.9% of all high school graduates who completed the university selection exam were able to continue their studies beyond high school. The findings indicate that the student's application and admission to Chilean colleges are significantly impacted locally by geographical factors—neighborhood features and distance from Santiago. Additionally, they find that the likelihood of applying to universities rises with distance to the capital city up to a threshold of 1400 kilometers, after which the likelihood starts to decline.

Data and Descriptive Statistics

We use administrative data from the Chilean Ministry of Education to build a panel that allows us to follow three cohorts of students through their last year of high school and their transition to higher education. These data are combined with administrative information on university applications supplied by the Department of Evaluation, Measurement, and Educational Registry (DEMRE), which also contains data on each student's family and test results from university entrance exams. We then merge this with the Ministry of Education data on higher education enrollment and major choice.

We track three cohorts of students who graduated from high school in 2014, 2015, and 2016 through their last year of high school and the application process into higher education, and pool these cohorts together. Although the raw data corresponds to a census, including the complete student population, in our panel we do not include students who did not graduate from high school, which means that we are looking at a somewhat selective group of urban and rural students. We group rural and mixed municipalities within the rural category. We conducted standard data validation procedures, eliminating duplicated cases, and out-of-range values, and checking the internal consistency of the data. This results in a dataset composed of 568,150 students, 418,801 of whom reside in urban areas, and 149,349 in rural areas. We consider that a rural student is a student who resides in a rural municipality as defined by Chile's National Statistics Institute.

For our analysis, we use two major metrics of educational performance: high school subject grades and university entrance exam scores. During the four years of high school, all students must study a number of mandatory subjects and choose several elective classes. The minimum grade needed to pass a course is 4.0, and the range of grades is 1.0 to 7.0. We also consider the results of the PSU exams, which range from 150 to 850 points, with a mean of 500 points. When applying to a selective university, both the GPA and PSU scores are taken into consideration. We define higher education broadly, consisting of professional institutes, technical institutes, and universities. The first two do not require applicants to have taken the PSU, while universities do.

We also obtain information on educational background from each student's mother and father, along with their families' income level, whether or not the parents are still living, who is recognized as the head of the family, as well as the type of school the student attended (public, voucher or subsidized, or private).

Table 1 displays the general descriptive statistics for our data, including the number of urban and rural students, their gender, the number of students in each cohort, and the type of school they attended. The main difference between the two groups is related to the type of school they attend. In urban areas, the majority (61%) of students attend voucher schools (subsidized private schools that generally require a low payment), and in rural areas, the majority of students attend public schools (51%). While 12.7% of urban students attend private schools, only 2.6% of rural students do.

Table 1. Descriptive Statistics by Geographic Area - 2014 to 2016

Variable	Rural	Urban
Total students	149,349	418,801
Female	69,769 (46.7)	204,007 (48.7)
Cohort		
2014	49,831 (33.4)	139,210 (33.2)
2015	50,206 (33.6)	140,751 (33.6)
2016	49,312 (33.0)	138,840 (33.2)
Type of School		
Public	64,767 (50.8)	101,349 (26.2)
Voucher	59,258 (46.5)	236,226 (61.1)
Private	3,349 (2.6)	49,082 (12.7)

Source: Calculations based on data from MINEDUC (2014)

Table 2 shows the percentage of urban and rural students who undertake each transition on the path of accessing higher education in the Chilean system. Of 149,349 rural students, 85% enroll in the higher education entrance exam, while 92% of urban students do so. Of those who enrolled in the test, 90% of rural students and 93% of urban students ended up taking the test. Among those who took the test, almost the same percentage of rural and urban students enroll in higher education (approximately 63%). After this transition, a larger difference appears when choosing to enroll in a university: 68% of students from urban areas do so, whereas only 59% of rural students do so. Finally, 26% of rural students enrolled in a university choose a STEM field, while 28% of urban students do so.

Table 2. Transitions by Geographic Area - 2014 to 2016

Variable		Rural		Urban	
	Total N in transition	N	%	N	%
Number of students	568,150	149,349	100%	418,801	100%
Enrollment in PSU	568,150	127,374	85%	386,657	92%
Took PSU	514,031	114,203	90%	359,206	93%
Enrollment in Any Type of Higher Education	473,409	70,759	62%	225,936	63%
Enrollment in University	296,695	41,535	59%	154,065	68%
Enrollment in STEM	195,600	10,979	26%	42,297	28%

Source: Calculations based on data from MINEDUC (2014)

When we consider students who completed the transition to any type of higher education, we include three types of institutions. Two of them are less selective, the Centers for Technical Formation (CFT) and Professional Institute (IP), while the third, universities, are generally more selective and require students to have taken the PSU admission exam.

We group higher education majors into broader categories used by the Ministry of Education to explore the differences in field choices by geographic area. These categories are agriculture, sciences, engineering, technology, social science, humanities and arts, business, law, education, and service management.

We also classify majors as belonging to a STEM field or not. The literature on STEM participation utilizes various definitions of which majors should be included in that category. In our main definition of STEM, we consider university majors in the fields of science, technology, engineering, and mathematics. We did not consider majors in Medicine, Nursing, or any health-related majors to be part of STEM in our analysis.

Table 3 shows the distribution of students from the three cohorts across these broad fields of study by geographic area. Engineering, industry, and construction is the most popular choice for urban students, with 25.1% choosing this field. Meanwhile, 25.9% of rural students major in health and social services. There is a noticeable difference in education majors, with 11.4% of rural students choosing this field compared to 7.4% of urban students.

Table 3. Major Enrollment by Geographic Area - 2014 to 2016

Variable	Rural	Urban
Total students	103,094	402,613
Major Group		
Agriculture	2,245 (3.8%)	5,282 (2.2%)
Science	3,603 (6.1%)	19,904 (8.3%)
Social Science, Business and Law	10,160 (17.1%)	56,912 (23.6%)
Education	6,811 (11.4%)	17,875 (7.4%)
Humanities and Arts	1,499 (2.5%)	12,648 (5.2%)
Engineering, Industry and Construction	14,576 (24.5%)	60,622 (25.1%)
Health and Social Services	15,445 (25.9%)	50,810 (21.1%)
Services Management	5,209 (8.7%)	17,204 (7.1%)

Source: Calculations based on data from MINEDUC (2014)

Table 4 focuses on the top 75 percentile of students in the distribution of the PSU math scores. This subgroup is examined to see if there are any significant variations at the top of the academic achievement distribution in terms of major choice. As the table shows, engineering attracts 30.6% of the urban students in the top 75 percentile of the PSU score distribution. Urban students also enroll in other fields, such as social sciences, where 24.5% of high-performing urban students enroll, compared with only 18.4% of high-performing rural students. Rural students within this group are more likely to enroll in Engineering and Health-related majors than urban students.

Table 4. Major Enrollment by Geographic Area for Top 75 Percentile in PSU Score - 2014 to 2016

Variable	Rural	Urban
Total students	15,510	115,922
Agriculture	375 (2.8%)	2,289 (2.4%)
Science	1,199 (9.0%)	10,168 (10.7%)
Social Science, Business and Law	2,445 (18.4%)	23,363 (24.5%)
Education	824 (6.2%)	4,698 (4.9%)
Humanities and Arts	297 (2.2%)	4,161 (4.4%)
Engineering, Industry and Construction	4,393 (33.1%)	29,140 (30.6%)
Health and Social Services	3,421 (25.8%)	19,365 (20.3%)
Services Management	313 (2.4%)	2031 (2.1%)
PSU Percentile	85.7 (7.1%)	87.7 (7.5%)

Source: Calculations based on data from MINEDUC (2014)

Empirical Framework

To explore the associations between the urban-rural divide and transitions to higher education, we est imate logistic regressions including an indicator variable identifying students residing in urban areas and a series of covariates. The variable of interest captures the relationship between urban areas and the different transitions to higher education. We control for relevant individual, family and geographic characteristics that could affect these transitions. The general equation we estimate is as follows:

$$Y_i = B_o + B_1 Urban_i + X_i + E_i \,, \qquad (1)$$

Y is a binary variable for each transition, which takes a value of 0 if student *i* did not complete that transition and a value of 1 if the student completed the transition. Urban is a binary variable that takes a value of 0 if a student lives in a rural area and a value of 1 if the student lives in an urban area. The X variables are controls for the characteristics of students, their families, and the schools they attend.

We first estimate models without controls as a baseline and then estimate them with controls. We do this for each dependent variable: enrolled in PSU, took PSU, enrolled in higher education, enrolled in university, and enrolled in a STEM major.

Results and Discussion

Our goal is to understand the association between residing in urban or rural areas and the probability of completing different stages in the transition to higher education. The results we find are in general consistent with the broader literature on urban-rural gaps in education achievement and performance. Even though rural conditions may vary largely across different countries, it is apparent that rural students face certain common challenges despite the different contexts. Table 5 and Table 6 present the results of estimating the logistic regressions described in the previous section, without and with controls.

Model 1 serves as our baseline, as it includes only a dummy variable for urban areas, with no controls. We find similar results to what we found when looking at descriptive statistics: urban students are more likely to complete each transition, but in some transitions, such as the transition to higher education, the gap between urban and rural students is small. This is consistent with studies on access to higher education in other developing countries such as Australia, China, South Africa, and India (Fleming & Grace, 2017; Chakrabarti, 2009; Mgqwashu et al., 2020; Yang, 2010). In Model 2, we add a binary variable for gender, the income level of each student's family, the type of school they attend, and geographic controls for the region in which the student resides. The coefficients remain largely unchanged despite the addition of these variables.

Table 5. Probability of Transition, Marginal Effects without Controls

	Enrolled PSU	Takes PSU	Enrolled Higher Ed	Enrolled University	Stem Major
Urban	0.070***	0.032***	0.009***	0.095***	0.032***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
N	568,150	514,031	475,409	296,695	195,600

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 6. Probability of Transition, Marginal Effects with Controls

	Enrolled PSU	Takes PSU	Enrolled Higher Ed	Enrolled University	Stem Major
Urban	0.066***	0.033***	0.008***	0.096***	0.026***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Controls					
Year	Yes	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes	Yes
Family controls	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes
N	568,150	514,031	475,409	296,695	195,600

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

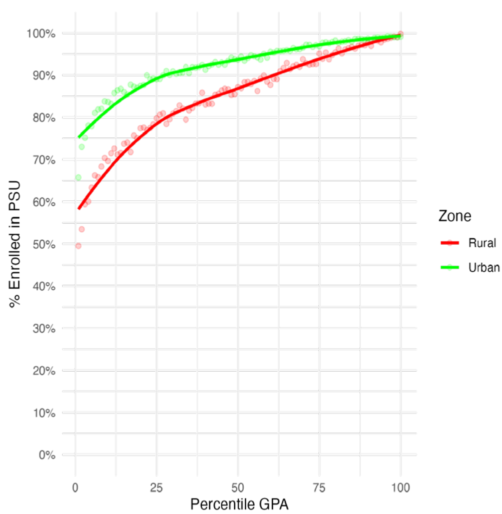
Column 1 of Table 6 shows that if we compare rural and urban students' enrollment in the PSU, urban students are about 7 percentage points more likely to enroll in the test than rural students.

Exploring the distribution of this first transition, enrolling in the PSU, which is completed by 514,031 students (90% of students who graduated high school) indicates that only the highest performing rural students match the enrollment rates of urban students. This suggests that rural students face an initial hurdle in their pathways towards higher education: students who are not in the top percentiles of school GPA are less likely to take the university entrance exam than urban students.

This can be seen in Figure 1, Panel (a), which shows there is a positive relationship between performance in school (as GPA percentile) and the percentage of students enrolling to take the PSU test, with urban students enrolling more relative to rural students, especially at the lower part of the GPA percentile distribution.

Figure 1, Panel (b) shows the second transition: taking the PSU. In this case, we focus on students who enrolled in the test and compare who ended up taking the test. Here, differences are less evident than in the first transition, although again it is clear that urban students are more likely to take the test than rural students across the whole GPA distribution.

Panel (a)



Panel (b)

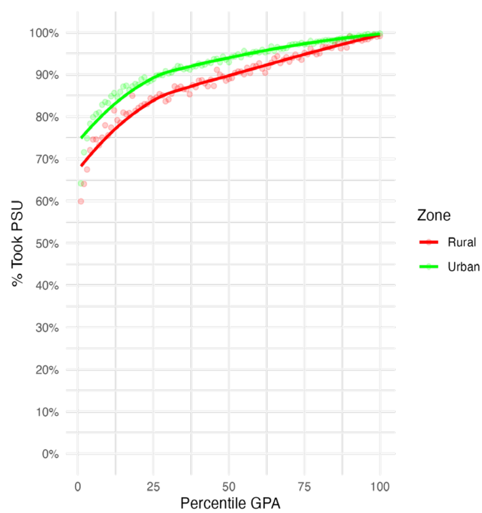


Figure 1. Percentage of Urban and Rural Students (a) Registering and (b) Taking the PSU test by GPA Percentile

Considering those who enroll in the PSU, urban students are 3 percentage points more likely to take the test as shown in Column 2 of Table 6. These results indicate that enrolling in the PSU is a larger barrier for rural students than actually taking the test once enrolled, but adding both transitions results in a substantial gap between both groups. This is in line with the literature's documentation of lower rates of college enrollment for rural students, highlighting a shared global challenge in facilitating the first steps toward higher education for students in rural areas (Scott et al., 2016; Wells et al., 2019).

International studies on higher education transitions have shown that socioeconomic factors have a significant impact on participation rates in postsecondary education (Smyth & Hannan, 2007; Chowdry et al., 2013). We can see this same trend in Chile by examining student's PSU take-up according to their family's income level, as shown in Figure 2. The differences in the distribution of urban and rural test-takers are more pronounced among students from low-income families. Urban and rural students from medium and high-income families are more similar when it comes to taking the PSU. This means that it is mainly low-income rural students who are less likely to take the university entrance exams.

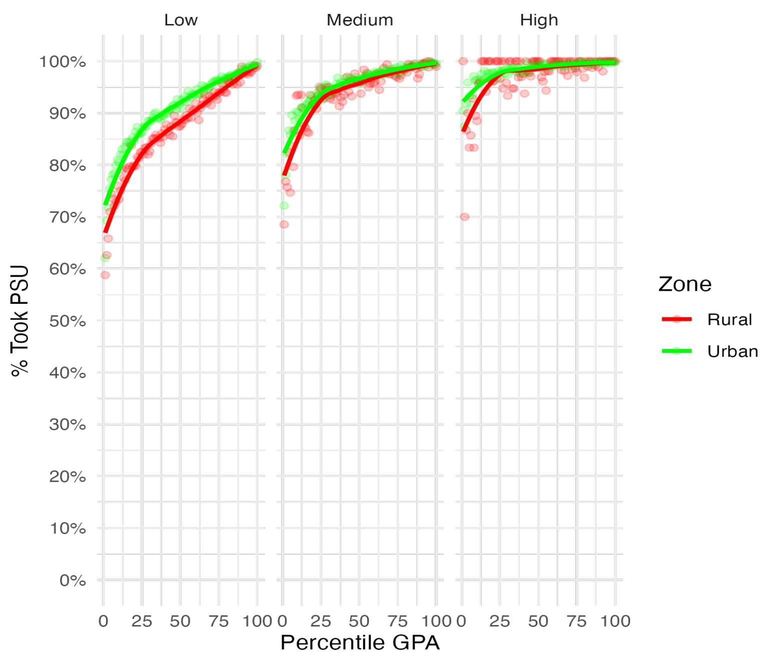


Figure 2. Percentage of Urban and Rural Students taking the PSU Test by GPA Percentile, by Income Level

Examination of PSU scores reveals substantial disparities in academic performance between students residing in urban and rural areas. Specifically, the analysis indicates that rural students tend to be predominantly situated within the lower stratum of the score distribution, suggesting comparatively weaker academic outcomes. Conversely, urban students consistently demonstrate higher test scores, illustrating a higher level of achievement, as can be seen in Figure 3, Panel (a). These differences are more pronounced for students from low and high-income families, in contrast with students from medium-income families in which, although the differences still exist, they are smaller. This can be seen in Figure 3, Panel (b). These differences between urban and rural students in Chile match an extended gap in urban-rural achievement, evidenced in several countries over the last decades (Cartwright & Allen, 2002; Tayyaba, 2012; Zarifa et at., 2019; Hillier et al., 2022).

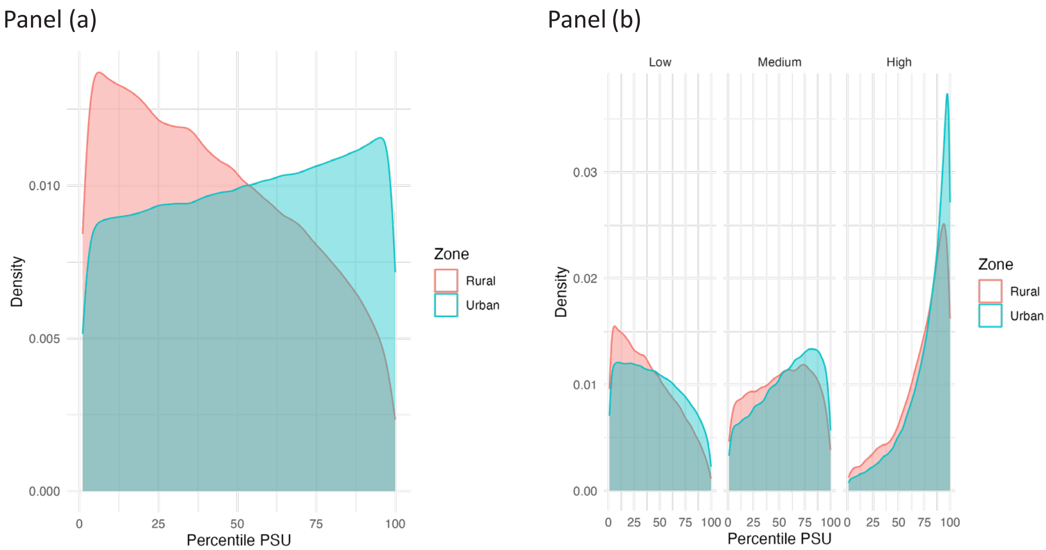


Figure 3. Density of Urban and Rural Students' PSU scores, Total and by Income Level

Column 3 in Table 6 shows that the third transition, enrolling in higher education, is completed at almost the same rate by urban and rural students, with urban students 1 percentage point more likely to enroll in higher education. This is relevant because although rural students are less likely to sign up and take the university entrance exam, this does not result in them being less likely to complete the transition to higher education. The reason for this is that students can enroll in higher education institutions that do not require entrance exams, and rural students are more likely to enroll in these types of institutions.

Figure 4 shows that rural students from lower percentiles of the PSU test distribution are more likely to enroll in higher education than urban students. But at the high end of the distribution, urban students are more likely to do so, and those segments contain large numbers of urban students while having few rural students.

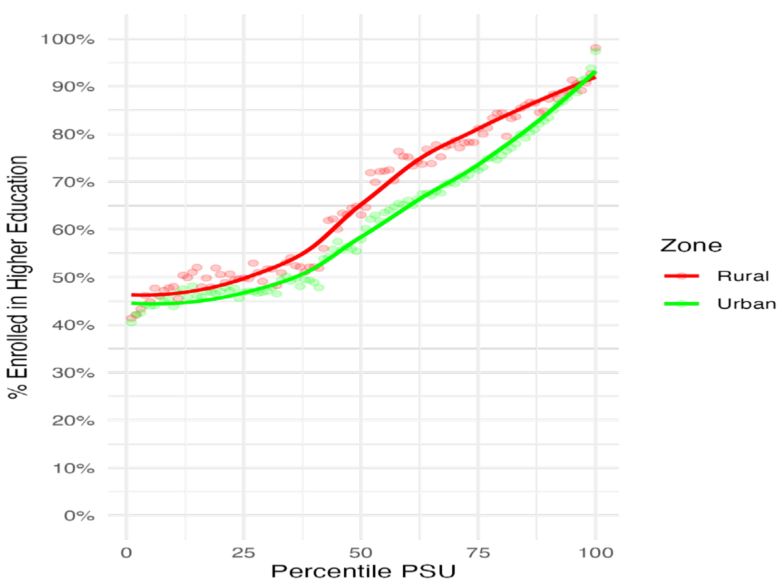


Figure 4. Percentage of Urban and Rural Students Enrolled in Higher Education by PSU Test Percentile

The largest difference between both groups of students appears in the transition to university, shown in Column 4 of Table 6. This transition is completed by 66% of students that enrolled in a higher education institution but there is a large gap: urban students are almost 10 percentage points more likely to enroll in a university than rural students. In this transition, we only consider students who took the PSU test, so they have at least shown an interest in attending a university and have taken steps to achieve this. Disparities in university enrollment rates might reflect in part the better performance of urban students in the PSU test, who end up taking most spots in selective universities.

If we look at students who enroll in universities, we see that urban and rural students are almost just as likely to enroll in a STEM major, as Column 5 in Table 6 shows. Rural students with high performances on the PSU test are more likely to enroll in these fields than urban students. In other contexts, it has also been documented that rural students enroll less often in STEM fields (Saw & Agger, 2021).

Figure 5 shows a positive relationship between PSU performance and enrollment in STEM majors, in which high-performing rural students are more likely to enroll in STEM majors. For rural students, it seems that performance during high school has a heavier weight in their decision to enter a STEM major than for urban students.

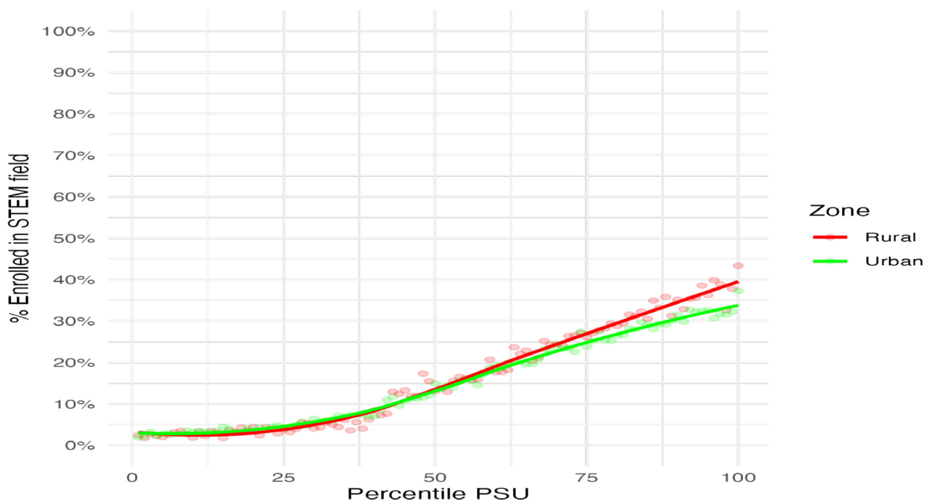


Figure 5. Percentage of Urban and Rural Students Enrolled in a STEM Field by PSU Test Percentile

Rural students likely face different costs and different opportunities when deciding on a university major. A rural student will more likely have to move to another part of the country to attend a selective university, while an urban student might have more options closer to where they reside. If STEM fields are higher paying on average, this might then be a more determinant factor when deciding on a major for rural students (Liao et al., 2013; Crain & Webber, 2021; Tran et al., 2021).

Rural students in Chile face several challenges when it comes to attending higher education, including lower test scores on standardized tests, which are used as the main entrance mechanism to universities. This suggests that policies aimed at bridging the rural-urban development divide should consider these challenges and take steps to address them. One way to do this would be to create a more comprehensive admissions system that takes into account geographic differences in student development. This could include providing additional support and resources to rural students, such as tutoring and mentoring, as well as giving them more opportunities to demonstrate their academic abilities in other ways besides standardized testing, such as through essays or interviews.

Conclusion

Our study adds several new perspectives to the body of knowledge on rural and urban, higher education. This study is one of the few in the body of literature that provides estimates of the underrepresentation of rural students in key transitions into higher education, leading towards STEM degree programs, based on a national population. Our findings expand upon and complement existing research from various contexts, including Australia, South Africa, China, and India. By focusing sequentially on each of the stages guiding students from high school to higher education institutions in Chile, and a specific focus on STEM fields, we address a significant gap in the literature, in which previous studies have offered insights into individual transition stages, but have not looked at the larger picture encompassing the barriers encountered by rural students in accessing higher education in developing countries. This comprehensive approach allows for a more nuanced understanding of the challenges faced by rural students.

Based on administrative data from high school graduates in Chile, we find that rural students are less likely to enroll in university entrance exams and perform significantly worse on them. These students enroll in higher education at similar rates, with urban students more likely to enroll in universities and rural students in technical or professional institutions. Even though urban students outperform rural students on standardized tests, both groups enroll in STEM professions in roughly equal numbers once they choose to pursue a university degree. When we examine this result, we show that students from rural areas with high performance on university entrance exams are more likely to pursue STEM careers than comparable students from urban areas. Thus, our research offers new insights into STEM career aspirations and choices. This unexpected finding warrants further investigation, potentially involving qualitative studies to explore underlying motivations and decision-making processes. Rural students are also less likely to enter social science or humanities majors, and more likely to enroll in health, education, services management, and agronomy.

There are several possible explanations for these findings. Rural students may have less access to quality education, which could lead to lower test scores (Zinth, 2014). They may also have less exposure to university-level academics, which could make them less likely to consider enrolling in university. Additionally, rural students may face financial barriers to attending university, as they may not be able to afford the cost of tuition or living expenses if having to move to a different region of the country (Scott et al., 2016; McNamee & Ganss, 2023). Our findings highlight the complexities of the rural-urban divide in higher education. While factors like lower educational quality in rural areas and financial barriers play a role (Gallego et al., 2007; Scott et al., 2016), other unobserved characteristics or interactions with individual and family circumstances might also influence educational choices.

These findings suggest that there are significant disparities in educational opportunities between rural and urban students in Chile, especially at specific transitions to higher education. These disparities need to be addressed to ensure that all students have the opportunity to reach their full potential.

Generating incentives and policies that help students from rural areas to enter universities and in particular STEM fields, would benefit those students and possibly the areas where they reside in the long run. It would also help reduce inequalities in a centralized admissions system that does not consider the different opportunity costs and barriers faced by students from rural areas when compared to students from urban areas, as highlighted in different contexts in studies by Scott et al. (2016) and McNamee & Ganss (2023). Further studies focused on the costs and limitations that rural students face when making the transition to higher education are required to better understand and address the gaps observed in the path towards higher education.

The implications of this study highlight the need for targeted interventions to address the disparities in educational opportunities between rural and urban students in Chile, especially during critical transitions into higher education. The underrepresentation of rural students in key pathways toward higher education, particularly in university enrollment, underscores the urgency of implementing policies and incentives aimed at facilitating their entry. Understanding why rural students are less likely to enroll in university entrance exams is essential to explore strategies that alleviate these challenges and create a more equitable educational landscape.

Efforts to bridge the educational gap should encompass not only financial support but also initiatives that enhance the quality of education and exposure to university-level academics in rural areas, as suggested by Fleming & Grace (2014) and Gao et al. (2022). Developing targeted programs to improve the performance of rural students in university entrance exams could be instrumental in increasing their representation in universities, as well as in STEM fields.

This study has two main limitations: (1) data is limited to students who remain in the education system, that is, students who fall behind significantly or drop out of the school system entirely are left out of our analysis; and (2), we cannot account for students that might follow alternative paths towards higher education. In this sense, our results and conclusions are limited only to those students who remain on a more traditional path, which might be especially relevant for rural students. Further studies are needed to explore these alternative pathways, and to understand how they might impact the choices made by urban and rural students.

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