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Unpacking the Black Box of First-Year College Attainment: Evidence from a Flagship Regional University in Chile

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Abstract: This study examines the factors influencing first-year college student success at a flagship regional university in Chile, focusing on academic progression and first-to-second year retention. Using administrative data and linear regression, we analyze the relationships between individual-level characteristics and students' likelihood of passing all courses and of persisting to the second year. Our findings reveal significant disparities across gender, high school background, admission type, and distance from campus. Notably, the factors associated with academic progression and retention are not always aligned, and early academic progression is particularly consequential. Surprisingly, students who delay entry after high school perform better academically and have higher retention

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rates. We also examine Chile's free college tuition policy, finding that while it is positively associated with retention, it is not significantly associated with academic progression. Our results underscore the importance of disaggregating first-year college outcomes and considering the unique challenges faced by different student subgroups to develop targeted interventions and support services.
Keywords: first-year college success; academic progression; retention; Chile; linear probability model

Desentrañando la "caja negra" del logro en el primer año universitario: Evidencia de una universidad regional emblemática en Chile

Resumen: Este estudio examina los factores que influyen en el éxito de los estudiantes de primer año universitario en una universidad regional emblemática de Chile, con énfasis en la progresión académica y la retención del primer al segundo año. Utilizando datos administrativos y modelado de regresión lineal, analizamos las relaciones entre las características a nivel individual y la probabilidad de que los estudiantes aprueben todos los cursos y persistan hasta el segundo año. Nuestros hallazgos revelan disparidades significativas basadas en género, antecedentes de educación secundaria, tipo de admisión y distancia geográfica del campus. Notablemente, los factores que influyen en la progresión académica y la retención no siempre están alineados, y la etapa en la que ocurre la progresión académica es importante. Sorprendentemente, los estudiantes que retrasan su ingreso después de la escuela secundaria presentan un mejor desempeño académico y tasas de retención más altas. También examinamos la política de gratuidad universitaria de Chile y encontramos que, si bien la condición de beneficiario se asocia positivamente con la retención, no tiene relación significativa con la progresión académica. Nuestros resultados subrayan la importancia de desagregar los resultados del primer año universitario y de considerar los desafíos únicos que enfrentan los diferentes subgrupos de estudiantes para desarrollar intervenciones y servicios de apoyo específicos.
Palabras clave: éxito de los estudiantes de primer año universitario; progresión académica; retención; Chile; modelado de probabilidad lineal

Desvendando a "caixa-preta" do desempenho no primeiro ano universitário: Evidências de uma universidade regional de destaque no Chile

Resumo: Este estudo examina os fatores que influenciam o sucesso dos estudantes no primeiro ano do ensino superior em uma universidade regional de destaque no Chile, com foco na progressão acadêmica e na retenção do primeiro para o segundo ano. Utilizando dados administrativos e regressão linear, analisamos as relações entre características em nível individual e a probabilidade de os estudantes serem aprovados em todas as disciplinas e de permanecerem até o segundo ano. Nossos resultados revelam disparidades significativas relacionadas a gênero, trajetória escolar no ensino médio, tipo de admissão e distância até o campus. Notavelmente, os fatores associados à progressão acadêmica e à retenção nem sempre estão alinhados, e a progressão acadêmica inicial mostra-se particularmente decisiva. De forma surpreendente, estudantes que adiam o ingresso após o ensino médio apresentam melhor desempenho acadêmico e maiores taxas de retenção. Também analisamos a política de gratuidade no ensino superior no Chile, constatando que, embora esteja positivamente associada à retenção, não apresenta associação significativa com a progressão acadêmica. Nossos resultados destacam a importância de desagregar os resultados do primeiro ano universitário e de considerar os desafios específicos enfrentados por diferentes subgrupos de estudantes para o desenvolvimento de intervenções e serviços de apoio direcionados.
Palavras-chave: sucesso no primeiro ano universitário; progressão acadêmica; retenção; Chile; modelo de probabilidade linear

Unpacking the Black Box of First-Year College Attainment: Evidence from a Flagship Regional University in Chile

First-year student success in college has been defined as an interrelated combination of academic achievement, critical thinking, and socio-emotional well-being (Van der Zanden et al., 2018). Yet achieving these multidimensional outcomes during the critical first year remains a significant challenge for many students (Clark, 2005). The first year of higher education represents the most critical juncture in students' academic trajectories: empirical evidence consistently demonstrates that attrition rates are highest during or immediately following the first year of enrollment, after which departure rates decline substantially and plateau (Ishitani, 2006; Tinto, 1993). This stage of progress is particularly consequential for equity: expanding access to higher education only translates to equity gains when students from disadvantaged backgrounds actually complete their degrees, yet research consistently shows that socioeconomic, racial, and first-generation status disparities in performance and persistence are most pronounced during the first year (Bailey & Dynarski, 2011; Odle et al., 2022). Because attrition and inequality are concentrated in this early window, understanding first-year success factors becomes paramount—interventions targeting later stages arrive too late for equity-seeking institutions. Put plainly, expanded access without adequate academic and institutional support does not constitute genuine educational opportunity; it risks becoming a revolving door that disproportionately cycles out the very students that access policies were designed to serve.

However, despite the critical importance of first-year outcomes, scholarship has historically relied on retention as the primary metric of freshman success, largely due to its administrative convenience and data availability (Hagedorn, 2005). Considerably less is known about credit accumulation patterns during the first year—a more granular indicator of academic progress toward degree completion—and virtually no research has examined whether the factors predicting retention differ from those driving credit completion, despite the distinct policy and practice implications such differentiation would entail (Adelman, 2006; Attewell et al., 2012). This knowledge gap is particularly consequential: if different factors predict enrollment persistence versus academic progression, institutions may be optimizing for the wrong outcomes or missing critical intervention opportunities. From a fiduciary standpoint, this distinction also carries direct financial implications: given that roughly 60% of dropout occurs within the first two years of enrollment (Ross et al., 2012), retaining students through this critical window is substantially more cost-effective than recruiting replacements—making first-year retention and progression not merely an equity concern but an institutional resource allocation priority.

We argue that there is a substantive reason to include credit accumulation metrics alongside first-year retention rates to assess freshman attainment. Unlike retention rates, which only indicate continuing enrollment, credit progression reflects actual academic advancement toward degree completion (Adelman, 2006; Attewell et al., 2012). Students can persist without progressing—a pattern that delays completion, increases costs, and may ultimately increase the risk of departure prior to degree attainment. In the Latin American context, where research on credit accumulation patterns remains less developed than in North American and European systems, our analysis provides early empirical evidence on how course completion metrics unfold in regional non-elite universities. Moreover, recent scholarship has highlighted the need for more nuanced indicators of first-year success beyond simple retention dichotomies (Santelices & Celis, 2022), particularly as Latin American higher education systems undergo rapid expansion and diversification.

The scale of this challenge is illustrated by recent regional data. According to the latest CIMA estimates, only 29% of young people aged 18 to 24 in Latin America attend tertiary

education, and just 19% of adults aged 25 to 34 have completed a post-secondary degree—well below the OECD average of 26% (Arias et al., 2025a). Critically, increased enrollment does not automatically translate into higher completion: Arias et al. (2025b) document that between 2006 and 2022, net attendance in post-secondary education grew by 36% across the region, while completion rates grew by 75%—yet attendance levels remain consistently higher than completion in virtually all countries. In this context, understanding what drives attrition during the first year of college is a necessary step toward explaining why the enrollment-to-graduation gap persists.

Academic momentum theory posits that early credit accumulation creates positive trajectories that compound over time, with students who fall behind in their first term facing increasingly difficult odds of catching up (Adelman, 2006; Attewell et al., 2012). This theoretical framework underscores the importance of disaggregating first-year outcomes temporally: if momentum builds (or stalls) as early as the fall semester, interventions deployed in spring or subsequent years may arrive too late to alter students' trajectories. Building on this need for temporally nuanced indicators, we turn to the Chilean context, where major policy reforms have reshaped the conditions under which students begin their studies.

In this context, our study aims to understand first-year college success in light of Chile's historic 2016 tuition-free policy (*Ley de Gratuidad*), which represents one of the most far-reaching tuition elimination reforms in recent Latin American postsecondary policy. Chile's 2016 implementation of free tuition emerged from massive student mobilizations in 2011 demanding educational reform and represents a fundamental shift in the country's market-oriented higher education model (Bellei et al., 2014; Delisle & Bernasconi, 2018). By examining cohorts from the early implementation phase of this policy, our research provides evidence on how traditional predictors of student success operate under Chile's new free-tuition regime and offers insights for ongoing policy debates about equity and access in Latin American higher education systems.

To ground these dynamics in a concrete institutional context, this study focuses on Universidad de Atacama, a regional public university serving predominantly first-generation, low-income students from Chile's mining region. Throughout this paper, we use the term "regional university" to denote non-metropolitan, geographically peripheral public institutions that serve dispersed and predominantly disadvantaged student populations—a category sometimes also described in the literature as peripheral or semi-peripheral institutions (Bernasconi & Celis, 2017; Santelices & Celis, 2022)

Chile's higher education expansion has not translated straightforwardly into greater equity: despite significant growth in enrollment, the system remains highly segmented, with students' socioeconomic backgrounds and school type independently shaping access to different institutional tiers, independent of academic merit (Espinoza et al., 2024). Regional universities in Latin America face distinct challenges compared to elite urban institutions: they enroll disproportionate shares of disadvantaged students, operate with more constrained resources, and serve geographically dispersed populations (Bernasconi & Celis, 2017). Despite their critical role in expanding access, regional institutions often receive less attention in Latin American higher education research. Nevertheless, the student experience literature has documented significant institutional heterogeneity across Latin America, with regional universities facing particular challenges in providing adequate academic and social supports (Santelices & Celis, 2022). By focusing on a regional institution during the early implementation of free tuition, our study illuminates how national access policies operate in contexts where students face multiple barriers beyond financial ones—including academic preparation gaps, first-generation status, and geographic distance.

These concerns have taken on renewed urgency with the growing adoption of learning analytics and AI-driven early alert systems in higher education, which aim to identify at-risk students before attrition occurs (Baneres et al., 2021; Chang et al., 2025). Yet the predictive validity of such

systems depends critically on which first-year indicators are used as inputs. If credit accumulation patterns are better or more immediate predictors of departure than enrollment continuity alone, institutions relying solely on retention-based signals may be intervening too late—underscoring the need for the kind of disaggregated, semester-level evidence this study provides.

This study addresses two research questions:

RQ1: To what extent do student characteristics and enrollment attributes predict first-year retention and, separately, credit accumulation outcomes among students at a regional Chilean university following the 2016 tuition-free policy implementation?

RQ2: To what extent do the factors predicting first-year retention differ from those predicting credit accumulation, and does this divergence manifest differently when comparing fall versus spring semester outcomes?

This study advances the literature on first-year college success in three distinct ways. First, it moves beyond the field's traditional reliance on retention as the primary indicator of freshman success by empirically disentangling enrollment persistence from academic progression and demonstrating that these outcomes are shaped by partially distinct mechanisms. Second, it introduces a temporal dimension to academic momentum theory by showing that the timing of first-year performance—particularly fall-term success—carries disproportionate predictive weight for second-year retention, underscoring the importance of semester-level analysis rather than aggregate annual measures. Third, by situating these dynamics within a stratified Latin American higher education system undergoing rapid expansion under a tuition-free policy regime, the study extends largely North American retention frameworks to non-metropolitan, resource-constrained public institutions, highlighting how financial access policies may influence persistence without necessarily altering academic progression. Together, these contributions refine both theoretical and policy understandings of how first-year trajectories unfold in massified and highly differentiated higher education systems.

Literature Review

Drivers of First-Year Retention Rates

Inquiries into the drivers of first-year retention tie back to Spady's (1970) sociological model and Tinto's (1975) classical interactional framework of college student retention. These models essentially argue that institutional integration drives retention by shaping students' commitments, where inadequate academic and/or social systems integration triggers a "withdrawal" decision pathway. Critically for first-year retention, Tinto highlights the first year as an intense period that shapes students' initial experiences with unfamiliar campus cultures and their tenuous establishment of affiliations (Tinto, 1988). Later frameworks of student persistence mirrored these insights, signaling the importance of informal contact with faculty, peer integration activities, and extracurricular engagement as instrumental to fostering student commitment to their institution and, thus, strengthening intentions and motivations to persist (Pascarella & Terenzini, 1980).

Empirical scholarship has profusely examined the student-level characteristics that influence withdrawal decisions after the first year. Pre-college academic preparedness has been tagged as highly predictive of first-year retention, including high school GPA, standardized test scores, and course rigor (Kahn & Nauta, 2001; Stewart et al., 2015). Students often struggle with the more complex first-year college workload due to prior gaps in rigorous high school academic preparation. These readiness gaps stem from broader educational inequities in school funding, teaching quality, curriculum rigor, and access to high-quality learning resources (Venezia & Jaeger, 2013). Students from more affluent high schools tend to be better primed for first-year college success, as they have

benefited from prior exposure to more rigorous coursework and enhanced educational resources in their high school environment (Jack, 2019; McDonough, 1997; Wolniak & Engberg, 2010).

There are also noticeable gender disparities in first-year retention outcomes. Research indicates that female students tend to exhibit higher levels of academic engagement, including participation in class discussions, seeking help from professors, and completing assignments on time (Sax, 2008). These behavioral patterns lead to higher motivation and commitment to their studies, resulting in increased first-year retention rates (Tinto, 1993). Female students also tend to perform better and gain more credits in their first semester of college, driven in part by the fact that male freshmen typically enter college with lower high school grades (Conger & Long, 2010).

The timing of the high school-to-college transition also seems to matter, though the evidence is less extensive. Evidence from the US suggests that students who delayed college entry after high school were more likely to leave college after their first year compared to those who entered immediately after high school graduation (Bozick & DeLuca, 2005). Consistent with this pattern, Adelman (2006), for example, found that direct entry into postsecondary education after high school is statistically associated with higher odds of degree completion. Thus, the later students arrive in their first year of college, the more higher education advancement is imperiled. However, these findings might be confounded by the fact that the bulk of students who delay postsecondary enrollment after high school have weaker academic preparation, lower parental educational attainment, and come from families with fewer economic resources (Attewell et al., 2012).

First-generation status in college has also been highly documented as predictive of lower first-year retention rates. First-generation college students often face additional challenges in transitioning to higher education environments compared to their non-first-generation peers. As the first in their families to attend college, first-generation students frequently lack valuable insider knowledge about the college experience and institutional navigation skills (Terenzini et al., 1996). For example, research shows that first-generation students tend to have less awareness of the time management strategies needed for college-level work and less understanding of college academic expectations and norms (Soto, 2016). They also typically have fewer financial, academic, and social support systems to rely on from parents or family members who have direct college experience. These disparities in cultural, social, and academic capital make it more challenging for many first-generation students to integrate into college culture (Terenzini et al., 1996). As a result, first-generation college students tend to face higher attrition rates due to lower levels of college readiness and less familial familiarity with navigating higher education systems (Ishitani, 2003).

Nevertheless, some efforts have been deployed to model first-year retention outcomes in the Latin American Region. Munizaga et al. (2018), for example, propose reformulating the factors associated with student retention into three categories: individual, sociodemographic, and institutional. The individual factors group together academic and personal variables. The sociodemographic factors include economic characteristics, along with variables such as parents' educational level and occupational status, which tend to be closely linked in the Latin American context. Finally, the institutional factors account for variables related to the institution's support during the student's education. This reconceptualization provides a useful framework for analyzing the complex and dynamic phenomenon of student retention in the particular context of Latin American higher education systems.

More recent scholarship has extended and refined these foundations in important ways. Gonçalves et al. (2024) conducted a systematic bibliometric review of retention research from 2014 to 2022 and identified three research fronts: institutional retention activities, student success activities, and student persistence factors. A key finding was that most retention initiatives in the literature remain fragmented at the course or department level rather than forming part of comprehensive institutional strategies, and that the field has been disproportionately focused on

North American and European contexts, with an explicit call for more research on Latin American higher education settings. In addition, Shields (2023) offered updated evidence on predictors of academic difficulty among first-semester students, reinforcing the critical role of the fall term as a pivotal window for identifying at-risk students. Taken together, this body of work underscores a growing consensus that retention is a multidimensional and temporally differentiated process, and that models developed primarily in elite North American or European contexts require adaptation for regional non-elite institutions serving first-generation and low-income populations (Munizaga et al., 2018; Santelices & Celis, 2022).

Recent syntheses of the retention literature further emphasize that first-year persistence reflects not only academic preparation and financial supports, but also institutional climate, psychosocial engagement, and students' sense of belonging. For example, Seidman (2024) highlights the systemic interplay between institutional design and student characteristics, while Bentrim and Henning (2023) underscore the central role of perceived inclusion and academic validation in sustaining enrollment. Although the administrative data used in the present study do not allow direct examination of belonging or socio-emotional integration, our findings complement this emerging body of work by disentangling academic progression from enrollment persistence. By distinguishing these outcomes empirically, we provide structural evidence that persistence may be maintained through mechanisms that are not reducible to credit accumulation alone, thereby offering a quantitative counterpart to more psychosocially oriented models of student retention.

Drivers of First-Year Credit Completion Outcomes

While retention factors have been thoroughly examined, far fewer studies empirically test determinants of credit attainment milestones or jointly situate both metrics. This is a significant knowledge gap because earning adequate credits early on predicts downstream outcomes such as timely graduation. The notion that first-year credit attainment shapes students' long-term trajectories dates back at least to 1999 (Adelman, 1999). The core idea was that the more credits the student earns at the beginning of their first year in college, the better their graduation rates by providing an early source of academic 'momentum' toward timely degree completion. Empirical research has substantiated this theory by showing that students who earn 20-30 credits in their first year are more likely to persist and graduate on time than those who fall behind early (Adelman, 2006; Davidson, 2015). In later work, Adelman (2006) advanced a more definitive formulation of this idea, arguing that "whenever the student first enrolls and earns credits in postsecondary education (summer, fall, winter, spring) marks the first academic calendar year of their postsecondary history" (p. 52).

Most of the scant empirical research on freshman credit completion outcomes is focused on U.S. postsecondary environments (Adelman, 2006; Attewell et al., 2012; Sodagari, 2025). The lack of attention to credits earned is puzzling, given the substantial financial aid and academic implications of first-year credit attainment. Earning an adequate number of credits is critical for meeting eligibility requirements to receive continued federal and state tuition assistance. In the United States, federal student aid programs require students to meet certain credit progress milestones ("satisfactory academic progress" or 67% of their cumulative credit hours attempted) to remain eligible for financial aid (Clark, 2020). Earning college credits in the first year is especially relevant for students planning to transfer from a community college to a 4-year university, as credit accumulation affects acceptance prospects and the transfer of credits (LaSota & Zumeta, 2016).

Another recent study of credit completion in the United States has shown that only 51% of degree-seeking full-time students earned 24 or more credit hours in their first year, indicating that the average full-time student will not be able to complete a bachelor's degree in five years. The rates of first-year credit attainment, measured as the ratio of credits earned to credits attempted in the first year, have also been shown to vary widely across student subgroups, especially by gender,

race/ethnicity, and enrollment intensity (i.e., full-time vs. part-time). For example, the percentage of Asian women meeting the 30-credit milestone in the first year of college more than doubled the share among Black/African American and Native Hawaiian/Other Pacific Islander female counterparts (Odle, et al. 2022).

In Chile, some attention has been given to credit completion and academic performance patterns. Administrative data shows that students enrolled in tertiary education typically miss 23% of their first-year classes on average (SIES, 2023). Recent longitudinal evidence further suggests that early academic performance is strongly stratified and highly persistent over time: secondary school GPA remains a significant predictor of university grades through at least the third year, while the predictive power of entrance exam scores fades after the first year (Espinoza et al., 2025). These patterns highlight the importance of understanding how early academic trajectories unfold, and motivate our empirical approach, which leverages rich administrative data to explore first-year credit accumulation and retention in a regional Chilean university.

Chile Free Tuition (*Gratuidad*) Policy

Ley de Gratuidad (Law 21.091), enacted in 2016, covers the full cost of tuition, enrollment, and administrative fees for eligible students, transferring the equivalent payment directly to participating institutions rather than to students. Eligibility is determined by family income: the policy initially covered students from the bottom five income deciles and was extended in 2018 to include the sixth decile. By the mid-2020s, *gratuidad* reached roughly half of all postsecondary students in Chile. Critically, the benefit is tied to continuous, timely enrollment and is granted only once in a student's lifetime—meaning that students who withdraw, fail out, or exceed their program's nominal duration lose eligibility permanently. Participation is automatic for state-owned universities such as Universidad de Atacama; private nonprofit institutions may also join, provided they meet accreditation and income-diversity requirements (Espínoza et al., 2023).

While the policy is often described as making college "free," this framing requires some qualification. *Gratuidad* eliminates direct tuition costs but does not cover living expenses, transportation, or materials—costs that remain a significant burden for low-income students, particularly those attending regional institutions far from their hometowns. Moreover, the state reimburses institutions at a regulated reference fee that has in many cases fallen below actual program costs, creating fiscal pressure that falls hardest on private non-state universities with fewer alternative revenue sources (Williamson et al., 2024). These structural features help explain why tuition elimination has been positively associated with enrollment retention without necessarily improving academic progression — a central puzzle this study examines.

The Case Study

Universidad de Atacama is a state-owned regional public university located in Chile's Atacama Region, one of the country's northernmost territories. The region is characterized by its geographic isolation, mining-dependent economy, and significant socioeconomic disparities. With a population of approximately 300,000 spread across vast desert terrain, the Atacama Region faces persistent educational inequities, including limited access to quality secondary education and scarce postsecondary options beyond Universidad de Atacama. The university operates two campuses: its main campus in Copiapó (the regional capital) and a smaller campus in Vallenar, located 150 kilometers to the south, serving one of Chile's most geographically dispersed student populations.

In addition, the Universidad de Atacama occupies a distinctive niche within Chile's stratified, market-oriented higher education system (Espinoza et al., 2025). Chile's postsecondary landscape is characterized by extreme institutional differentiation: elite research universities concentrate in Santiago and major urban centers, enrolling predominantly affluent students with strong academic

preparation, while regional public universities, such as Universidad de Atacama, serve equity-seeking populations with substantially fewer resources per student (Delisle & Bernasconi, 2018).

Universidad de Atacama faces persistent challenges in academic progression, retention, and timely degree completion—challenges that intensified following the implementation of *gratuidad*, as expanded access may have increased heterogeneity in students' prior academic preparation. During the 2020-2024 period, first-year retention rates averaged 82% in professional bachelor's degree programs and 79% in non-baccalaureate programs, compared to an institutional average of 68% overall. Technical programs offered at the Vallenar campus have exhibited particularly concerning retention patterns in recent years.

In terms of institutional size, Universidad de Atacama enrolls approximately 2,000 new first-year students annually, with a total enrollment of roughly 8,000 students across both campuses during the study period. The institution offers programs across several disciplines, including engineering and mining technology, health sciences, education, business administration, and social sciences. These programs are distributed across both campuses, with the Vallenar campus focusing primarily on technical and applied programs. Persistence rates vary substantially across these program areas: engineering, law, and health sciences programs tend to exhibit higher first-to-second-year retention rates (above 80%), while technical and vocational programs, particularly those at the Vallenar campus, show persistently lower rates (see Table A1 in Appendix for first-, second-, and third-year retention rates by program type and academic department, 2020–2024).

Recognizing these challenges, Universidad de Atacama has implemented several student support initiatives, though resource constraints limit their scale and scope. For instance, the Comprehensive Student Support System (in Spanish, *Sistema de Apoyo Integral al Estudiante*, SAIE), established in 2019, provides academic tutoring, peer mentoring, and psychosocial support services to at-risk students. Participation in SAIE is associated with higher course approval rates than cohort averages, suggesting potential effectiveness, though selection effects (e.g., more motivated students may seek support) complicate causal interpretation (Universidad de Atacama, 2025). While these initiatives are promising, their effective targeting depends on identifying early and reliable signals of academic risk—an objective that motivates our empirical focus on first-year credit accumulation patterns.

Empirical Approach

To empirically assess these relationships, we analyzed comprehensive administrative datasets covering multiple cohorts of first-year students.

Data

This study draws on a comprehensive dataset of more than 10,000 observations from 5 first-year student cohorts at the University of Atacama in Chile, from 2016 to 2020. The data were obtained through ongoing collaboration with the university's Institutional Research Unit, which provided access for research purposes. All records were de-identified prior to analysis to remove direct personal identifiers, and the use of these administrative data was conducted under the oversight of the University of Atacama's Institutional Research Office.

Student attributes included demographic factors and pre-college data, such as years since high school graduation. Students' high school information prior to matriculation was added from an administrative dataset provided by the Ministry of Education of Chile and linked to the University of Atacama institutional records using individual identifiers. This allowed the inclusion of academic history before postsecondary enrollment, such as high school graduation timing, along with other pre-college controls.

Variables

Our analysis includes two types of outcome variables. The first set consists of academic progression outcomes that capture students' course-completion patterns during the first year. These include indicators of whether students passed all courses taken in the fall semester, in the spring semester, and across the full academic year (conditional on taking spring courses). These measures allow us to assess early academic performance at multiple points during the first year. The second outcome variable is first-to-second-year retention, a dichotomous measure based on institutional enrollment records that indicates whether a first-year student re-enrolled at the same institution the following academic year.

Predictor variables fall into three conceptual groups. The first group, student attributes, includes demographic and pre-college characteristics such as gender, first-generation status, international student status, and high school type (public, private voucher, or private). The second group, enrollment attributes, captures features of students' entry into the institution, including years since high school graduation, distance from the hometown to the campus, receipt of a state-backed loan or free tuition, and admission route (regular or alternative pathways).

A third set of predictors is early academic progression indicators. These are included only in the retention models. These variables summarize students' academic performance during the first year and help explain variation in persistence. They include standardized first-year GPA, indicators for passing all fall-term or all spring-term courses, whether any spring courses were failed, whether no courses were taken in the spring, and whether all first-year courses were completed. Although these progression metrics reflect academic performance, they are treated as predictors rather than outcomes in the retention models, as they precede and help explain students' decision to return for a second year.

Sample

Descriptive statistics for all relevant variables are presented in Table 1, which illustrates substantial variation in both academic progression and persistence during the first year. Around 61% of students pass all fall-term courses and 65% pass all spring-term courses (among those taking classes); however, about 17% of students do not enroll in any courses during the spring term, suggesting the relevance of accounting for within-year enrollment patterns when examining first-year success. Only about half (53%) pass all courses across the full academic year (conditional on spring enrollment), while roughly 80% of students are retained into the second year, suggesting a meaningful divergence between academic progression and enrollment persistence.

The composition of the student body further reflects the study's specific context. Fewer than 1% of students are international, and only 2% graduated from fully private high schools (well below the national average for both figures), indicating that the institution predominantly serves students from publicly funded secondary schools. More than 80% of students have no parent with a college degree (measured for N=8,599 students with parent-education data), meaning that a sizable share of the sample faces barriers associated with first-generation status.

Enrollment characteristics also point to certain trajectories that may shape early academic outcomes. Only 40% of students enter college right after graduating from high school, with an average delay of 3.6 years, with most of the age variation coming from students entering evening programs or vocational degrees. In addition, approximately 96% of students come from within 200 km of campus. More than 60% of students receive free college tuition (available starting from the 2016 cohort), and about 38% are admitted through the regular national admissions pathway, reflecting the coexistence of merit-based and alternative entry routes. For school-specific enrollment, see Table A2 in the Appendix.

Table 1

Descriptive Statistics

Variable	Definition	*N*	Mean	*SD*	Min	Max
Outcome variables						
Fall term pass all	Student pass all taken fall courses	10539	.612	.487	0	1
Spring term pass all	Students pass all spring courses	8749	.648	.478	0	1
First-year pass all	Students pass all courses (conditional on spring enrollment)	8749	.534	.499	0	1
Retained	Students enroll in second year at same institution	10539	.798	.401	0	1
Student characteristics						
Female	Student gender is female	10539	.473	.499	0	1
First-generation (college)	Students' parents have no college degree (either)	8599	.816	.387	0	1
Foreign	Student is not Chilean	9926	.007	.082	0	1
High school type						
Public	State-administered	10539	.49	.5	0	1
Private voucher	Privately run, publicly funded	10539	.43	.495	0	1
Private	Privately run and funded	10539	.022	.146	0	1
College enrollment attributes						
Just graduated from high school	Student graduated from high school right before enrollment	10539	.398	.49	0	1
Years since high school graduation (0 = no delay)	Years since students graduated from high school	10534	3.627	5.512	0	43
Main campus	Students attend classes in main campus	10539	.815	.388	0	1
Day shift (0 = evening)	Program is offered during daytime hours	10539	.607	.488	0	1
College degree (0 = technical/vocational)	Program leads to a professional (college-level) degree	10539	.572	.495	0	1
Distance to hometown (>200 km)	Student hometown is further than 200 km from campus	10539	.039	.194	0	1
State-backed loan	Students hold a government-backed loan	10539	.029	.169	0	1
Free college	Students have free college tuition (starting 2016)	10539	.635	.481	0	1
Regular admission	Student admitted through regular path (college entrance exam)	10539	.375	.484	0	1
Early academic progression indicators						
No spring enrollment (no courses)	Students did not take any courses in the spring	10539	.17	.376	0	1
First-year GPA (z-score)	GPA standardized by major	10539	.021	1.002	-6.31	3.257
Cohort indicators						
2016		10539	.196	.397	0	1
2017		10539	.212	.409	0	1
2018	Entry to college	10539	.21	.408	0	1
2019		10539	.212	.409	0	1
2020		10539	.169	.375	0	1

Note: the table reports descriptive statistics pooled across first-year cohorts. Free college tuition was implemented nationally in 2016; students in earlier cohorts were not eligible, while eligibility among later cohorts reflects policy rules and student characteristics. Academic progression measures capture course completion at different points during the first year.

Methods

This study examines how individual and enrollment factors are associated with first-year academic progression and retention at the student level. Because the outcome variables are binary, we estimate Linear Probability Models (LPMs), which correspond to Ordinary Least Squares (OLS) regressions applied to a dichotomous dependent variable. In this framework, OLS yields consistent estimates of the conditional expectation of the outcome, interpreted as changes in predicted probabilities associated with differences in student characteristics. Coefficients therefore represent percentage-point differences in the likelihood of the outcome, conditional on included covariates. Importantly, coefficients are interpreted as associations rather than causal effects. The linear specification provides transparent and policy-relevant estimates that are straightforward to interpret (Hellevik, 2009). To account for systematic differences across entry cohorts and fields of study, all models include cohort fixed effects and major fixed effects, and standard errors are clustered at the major level.

We model the probability that a student i in cohort c and major m attains outcome y_{icm} as follows:

$$p(y_{icm} = 1 \mid X_i, Z_i, \delta_c, \mu_m) = \alpha + X'_i\beta + Z'_i\gamma + \delta_c, + \mu_m + \varepsilon_{icm}$$

Where y_{icm} denotes a binary outcome (academic progression indicators or first-to-second-year retention), X_i is a vector of student attributes (e.g., gender, first-generation status, high school type), Z_i is a vector of enrollment attributes (e.g., years since high school graduation, admission type, financial aid), δ_c represents cohort fixed effects, μ_m represents major fixed effects, and ε_{icm} is an idiosyncratic error term.

Because outcomes are binary, the model is estimated as a Linear Probability Model (LPM) using OLS, and the coefficients are interpreted as percentage-point associations, capturing conditional differences in predicted probabilities. In the case of binary independent variables, the coefficients represent the difference in the probability of the outcome between observations where the variable takes values of 0 and 1, holding all other variables constant (Wooldridge, 2010). In retention models, Z_i additionally includes early academic progression indicators from the first year, such as GPA and course completion measures.

Results

Table 2 presents the results of the associations of academic progression at different points during the first year. We begin with a structural specification that includes cohort fixed effects and program/enrollment attributes and then move to our preferred models that absorb both cohort and major fixed effects. This structure allows us to assess whether and when early academic performance is most strongly associated with persistence.

Across all academic progression outcomes, female students generally exhibit a higher probability of passing their courses across all terms (Fall, Spring, and the entire academic year). In the structural specifications (columns 1, 4, and 7), the female advantage ranges from 6.3 to 13.2 percentage points. Once major fixed effects are introduced (columns 2, 5, and 8) and enrollment characteristics are added (columns 3, 6, and 9), the magnitude attenuates but remains statistically significant.

Table 2

Associations between Student Characteristics, Enrollment Conditions, and First-Year Academic Progression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Fall-term pass all			**Spring-term pass all**			**First-year pass all (conditional on spring enrollment)**		
Student characteristics									
Female	0.063***	0.030*	0.027*	0.132***	0.039**	0.048***	0.113***	0.031*	0.033*
	(0.024)	(0.016)	(0.016)	(0.022)	(0.016)	(0.018)	(0.024)	(0.018)	(0.017)
First Gen (college)	0.007	-0.015	-0.001	-0.005	-0.001	-0.008	0.008	-0.009	-0.003
	(0.014)	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
Foreign	-0.111*	-0.123**	-0.076	-0.055	-0.056	-0.025	-0.080	-0.075	-0.050
	(0.059)	(0.060)	(0.062)	(0.053)	(0.052)	(0.053)	(0.057)	(0.059)	(0.058)
High School Type (base = Public)									
Private Voucher	0.054***	0.077***	0.071***	0.035**	0.067***	0.062***	0.033**	0.068***	0.060***
	(0.014)	(0.011)	(0.011)	(0.016)	(0.011)	(0.012)	(0.017)	(0.012)	(0.013)
Private	0.020	0.039	0.024	-0.025	0.015	-0.004	-0.011	0.020	-0.001
	(0.038)	(0.039)	(0.035)	(0.048)	(0.028)	(0.040)	(0.045)	(0.024)	(0.028)
College enrollment attributes									
Years since high school graduation	0.010***		0.009***	0.011***		0.012***	0.012***		0.011***
	(0.003)		(0.002)	(0.002)		(0.002)	(0.003)		(0.003)
Main campus	-0.070			-0.051			-0.091		
	(0.047)			(0.053)			(0.055)		
Day shift	-0.040			0.038			-0.032		
	(0.036)			(0.050)			(0.047)		
College degree	-0.117***			-0.081*			-0.108**		
	(0.042)			(0.048)			(0.049)		
Distance to hometown (>200 km)	0.023		0.024	0.003		-0.024	0.022		-0.005
	(0.044)		(0.036)	(0.040)		(0.021)	(0.055)		(0.026)
State-backed loan	0.007		-0.001	0.030		0.025	-0.003		-0.010
	(0.028)		(0.030)	(0.032)		(0.034)	(0.037)		(0.038)
Free college	0.024*		0.020*	0.004		0.002	0.004		0.004
	(0.014)		(0.012)	(0.016)		(0.014)	(0.014)		(0.012)
Regular admission	0.050*		0.092***	0.079**		0.044***	0.091***		0.095***
	(0.030)		(0.021)	(0.031)		(0.013)	(0.029)		(0.018)
Fixed effects									
Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constant	0.640***	0.541***	0.481***	0.572***	0.576***	0.552***	0.542***	0.460***	0.413***
	(0.042)	(0.013)	(0.017)	(0.037)	(0.016)	(0.021)	(0.045)	(0.015)	(0.017)
Observations	8,547	9,876	8,545	7,104	7,956	7,102	7,104	7,956	7,102
R-squared	0.063	0.149	0.163	0.078	0.157	0.170	0.093	0.185	0.200

Note. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ Table reports coefficients from Linear Probability Models. Models estimate associations with academic progression outcomes (passing all courses in the fall, spring, and full academic year. Cohort and major fixed effects vary by model. Standard errors are clustered at the major level in all models. Observation counts vary by outcome due to students with no courses in a term and missing covariates (e.g., parental education), and because 'pass all' outcomes are defined conditional on taking courses.

First-generation students show small, negative point estimates across specifications; however, these are not statistically significant, indicating no clear disadvantage once observable characteristics are taken into account. Meanwhile, high school background is also strongly associated with academic progression. Students from private voucher high schools show a substantial advantage. In the preferred models with major fixed effects (columns 2, 5, and 8), students are approximately 6 to 7 percentage points more likely to pass all courses than students from public schools. This pattern persists after adding enrollment controls, indicating that differences in prior preparation remain salient within majors. In contrast, no significant differences are observed for students from fully private high schools, likely due to their limited representation in the sample.

Turning to enrollment characteristics, years since high school graduation is positively and significantly associated with academic progression across all specifications in which it is included. Program-level characteristics—main campus location, day shift, and degree type—are estimated only in the models without major fixed effects. In these same models, college-degree programs (relative to technical/vocational programs) are significantly associated with lower course-passing, suggesting that college-degree courses present greater challenges for students than vocational-technical ones.

Financial aid variables, including state-backed loans and free college eligibility, show limited and generally statistically insignificant associations with course pass rates. This null finding likely reflects the fact that our sample consists exclusively of enrolled students, for whom binding financial constraints may have already been resolved at the point of entry. However, students admitted through the college entrance exam (regular admission) saw a significant increase in all course pass rates, with up to a 9.5 percentage point advantage over those admitted through alternative pathways, suggesting the importance of academic selection in shaping first-year performance, even within an expanded-access policy regime.

For robustness, Table A3 in the Appendix presents the same specifications as columns (1)–(6) but using the continuous pass-rate measures instead of the dichotomized outcomes. The main outcomes were dichotomized because the original pass-rate variables are highly skewed toward one, with limited dispersion below full course completion. The results using continuous measures are qualitatively similar, reinforcing the robustness of our findings.

Table 3 shifts the focus from academic progression to first-to-second-year retention. Columns (1)– (3) present baseline specifications, beginning with a structural model including cohort fixed effects (column 1) and then moving to preferred models that absorb both cohort and major fixed effects (columns 2 and 3). In contrast to the progression results in Table 2, several patterns emerge that suggest persistence is shaped by a broader set of constraints than course performance alone.

First-generation students exhibit a consistent disadvantage in retention in the baseline and major fixed-effects models, with persistence probabilities 1.4 to 2.5 percentage points lower than those of their continuing-generation peers. This gap is statistically significant in most specifications, even though first-generation students did not display systematic disadvantages in passing all courses in Table 2. Similarly, students who relocate more than 200 kilometers from campus face substantially lower retention rates. These patterns suggest that geographic and informational barriers may affect students' ability to remain enrolled even when academic performance is in good standing.

Financial aid variables are strongly associated with persistence. Both state-backed loans and free college eligibility show large and statistically significant positive correlations with retention in baseline models, with free college linked to increases in persistence exceeding 12 percentage points. Regular admission through the national entrance examination is also positively associated with retention, although this effect attenuates once additional controls and progression measures are introduced. These findings indicate that institutional access and financial support mechanisms play an important role in sustaining enrollment beyond the first year.

Table 3

Associations between Student Characteristics, Enrollment Conditions, and First-Year Retention

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Retained			
Student characteristics								
Female	0.034**	0.027**	0.016	-0.013	0.009	0.013	0.017	0.021*
	(0.013)	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)
First Gen (college)	-0.022*	-0.014	-0.025**	-0.019**	-0.024**	-0.018*	-0.015	-0.016
	(0.011)	(0.011)	(0.012)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Foreign	-0.092	-0.062	-0.074	-0.054	-0.054	-0.061	-0.003	0.001
	(0.067)	(0.069)	(0.067)	(0.059)	(0.065)	(0.059)	(0.059)	(0.059)
High School Type (base = Public)								
Private Voucher	0.049***	0.042***	0.052***	0.012*	0.033***	0.044***	0.025***	0.028***
	(0.009)	(0.009)	(0.009)	(0.007)	(0.009)	(0.008)	(0.008)	(0.008)
Private	0.049	-0.009	0.047	0.029	0.041	0.037	0.043	0.042
	(0.032)	(0.034)	(0.034)	(0.030)	(0.031)	(0.029)	(0.030)	(0.029)
College enrollment attributes								
Years since high school graduation	0.007***		0.006***	0.001	0.003**	0.004***	0.001	0.002
	(0.001)		(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Main campus	-0.047**							
	(0.023)							
Day shift	0.029							
	(0.020)							
College degree	0.020							
	(0.019)							
Distance to hometown (>200 km)	-0.081***		-0.095***	-0.076***	-0.101***	-0.080***	-0.028	-0.033
	(0.026)		(0.025)	(0.023)	(0.024)	(0.024)	(0.019)	(0.020)
State-backed loan	0.110***		0.096***	0.071***	0.096***	0.073***	0.039	0.047*
	(0.022)		(0.022)	(0.018)	(0.021)	(0.022)	(0.024)	(0.025)
Free college	0.129***		0.124***	0.115***	0.119***	0.099***	0.077***	0.077***
	(0.012)		(0.012)	(0.010)	(0.011)	(0.012)	(0.010)	(0.010)
Regular admission	0.052***		0.058***	0.017	0.033***	0.035**	0.035***	0.028**
	(0.010)		(0.010)	(0.011)	(0.011)	(0.014)	(0.013)	(0.012)
Progression metrics								
First-year GPA (z-score)				0.184***				
				(0.007)				
Fall-term pass all					0.264***			
					(0.018)			
No spring enrollment (no courses)						-0.472***		
						(0.058)		
Spring-term pass all							0.233***	

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Retained				
							(0.015)	
First-year pass all (conditional on spring enrollment)								0.189***
								(0.015)
Fixed effects								
Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.671***	0.787***	0.678***	0.735***	0.551***	0.788***	0.644***	0.694***
	(0.024)	(0.014)	(0.018)	(0.014)	(0.021)	(0.018)	(0.019)	(0.016)
Observations	8,547	9,876	8,545	8,545	8,545	8,545	7,102	7,102
R-squared	0.049	0.051	0.075	0.267	0.165	0.227	0.147	0.118

Note. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ Table reports coefficients from Linear Probability Models. Models estimate associations with first-year retention. Cohort and major fixed effects vary by model. Standard errors are clustered at the major level in all models. Observation counts vary by outcome due to students with no courses in a term and missing covariates (e.g., parental education), and because 'pass all' outcomes are defined conditional on taking courses.

To further examine the role of academic performance in shaping persistence, we estimate a series of retention models (models 4–8) that sequentially incorporate alternative measures of first-year academic progression. These progression measures were analyzed as outcomes in earlier models (Table 2) and are subsequently introduced here as covariates. This modeling strategy is intentional, allowing us to examine whether early academic performance mediates the observed retention gaps.

Across these specifications, academic performance emerges as a strong correlate of retention. A one–standard deviation increase in first-year GPA (column 4) is associated with an 18.4 percentage point higher probability of returning for the second year. Passing all courses is even more strongly linked to higher retention. Notably, fall-term performance shows the strongest association, with students who pass all fall courses showing a 26.2 percentage-point increase in retention, suggesting that early academic momentum plays a particularly important role. In contrast, enrollment disruptions are highly consequential: students who do not enroll in the spring semester experience a reduction in retention probability exceeding 47 percentage points. This association is partly mechanical, as midyear non-enrollment may reflect early attrition. Nevertheless, its magnitude underscores how decisions or constraints that lead students to disengage during the academic year strongly predict subsequent non-persistence. Importantly, the inclusion of academic progression measures attenuates some background effects. For example, the first-generation disadvantage becomes smaller and even statistically insignificant once progression metrics are included. Likewise, the negative association between geographic distance and retention diminishes in magnitude when academic progression is controlled for. These patterns indicate that academic success during the first year operates as a key mechanism linking student background to continued enrollment.

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Comparing Tables 2 and 3 reveals that the determinants of academic progression and retention are related but not identical. While gender and high school background strongly predict credit accumulation, geographic distance and financial aid exhibit much stronger associations with retention than with course completion. This divergence suggests that persistence decisions reflect broader structural and economic constraints beyond academic performance alone. Moreover, timing matters: fall-term academic success is more strongly associated with second-year retention than spring performance, and midyear non-enrollment is a particularly strong predictor of departure. Together, these patterns indicate that the mechanisms underlying early academic progression differ in important ways from those shaping persistence, especially across semesters.

In the following section, we interpret these patterns in light of existing theories of first-year success and discuss what they reveal about the distinct determinants of academic progression and retention.

Discussion

Our study explored the relationships between various student-level factors and first-year college progression metrics, including fall and spring course pass rates, overall first-year course pass rates, and retention from the first to the second year. We situated our study in a regional, non-elite university placed in Chile, whose postsecondary system is recognized as one of the most socioeconomically polarized in the world (Espinoza et al., 2025). We advocated for a more granular, textured empirical treatment of first-year academic attainment in college, countering prior literature that has often relied on aggregate, lagged measures or focused solely on retention outcomes (Gonçalves et al., 2024; Veenstra, 2009).

Overall, this study highlighted the importance of not treating first-year academic success as monolithic. By examining the progression of fall and spring alongside retention, we show that determinants vary by outcome and timing. This nuanced approach to understanding first-year attainment challenges the notion that the freshman year can be treated as a singular, uniform experience and underscores the need for targeted, time-sensitive interventions that address the unique challenges students face at different stages of their academic journey.

When considering students' characteristics, our findings play up the importance of gender, high school type, age at enrollment, and admission type in predicting all course pass rates. Female students consistently outperformed their male counterparts, while students from private voucher high schools showed a significant advantage over those from public schools. Older students at the time of enrollment also displayed higher probability of passing all courses, particularly in the first year Spring term. In addition, regular admission through the college entrance exam was associated with a significant increase in all course pass rates compared to alternative admission pathways. These results align with previous research suggesting that gender (Conger & Long, 2010), and high school background (Venezia & Jaeger, 2013) can influence academic performance in the first year in higher education. The advantage of regular admission through the college entrance exam may stem from the exam's ability to triage students with stronger academic preparation and motivation (Avery & Kane, 2004). This is particularly relevant in the Chilean context, where the college entrance exam plays a significant role in determining access to higher education (Bernasconi & Rojas, 2004; Espinoza et al., 2024; Espinoza et al., 2025).

Yet when shifting from academic progression to enrollment persistence, a somewhat different pattern emerges. Our analysis revealed that factors such as being female, graduating from a private voucher high school, being older at enrollment, receiving financial aid, and entering college through regular admission positively influence retention. Importantly, the retention disadvantages associated with first-generation status and geographic distance, along with the advantages associated

with delayed entry and regular admission, diminish once first-year academic performance is controlled for, suggesting that academic momentum partially mediates these relationships. This attenuation is theoretically consequential. It suggests that academic momentum operates as a mediating mechanism linking student background to persistence.

Our study revealed a positive, statistically significant association between receiving free college tuition and first-to-second-year retention, with students receiving free tuition having a 12.3 percentage-point higher probability of persisting to the second year than their peers, contradicting prior studies (Clasing, 2022). However, we did not find a significant association between free college tuition and improved progression outcomes, such as passing all courses in spring or fall. This divergence raises important questions about the mechanisms by which tuition-free policy influences student trajectories, given that Chile's free college tuition policy requires students to maintain continuous enrollment within the nominal duration of their degree program, as the benefit does not cover academic delays or failed coursework (Páez, 2022). The fact that free tuition is strongly associated with enrollment persistence but not with credit accumulation suggests that financial relief may stabilize short-term enrollment without necessarily strengthening students' academic momentum. In this sense, expanded access does not automatically translate into expanded opportunity, as qualitative evidence suggests (Llona et al., 2023). Without complementary investments in academic preparation, advising, and support infrastructure—especially at regional institutions serving disadvantaged populations—tuition elimination alone may increase persistence at the margin while leaving underlying academic vulnerabilities intact.

In this study, we adopted a stringent definition of first-generation status, classifying students as first-generation only if neither of their parents had earned a college degree. Surprisingly, our results indicated that, under this definition, being a first-generation student does not have a significant impact on progression outcomes, such as passing all courses. First-generation students exhibit lower retention in baseline models; however, this gap attenuates once early academic progression is controlled for, suggesting that performance-based mechanisms explain much of the observed persistence gap. This finding suggests that while first-generation students may face unique challenges in persisting from the first to the second year, these challenges do not necessarily translate into poorer academic progress during their first year. This distinction highlights the importance of examining multiple dimensions of student success, as factors that influence retention may not always align with those that affect academic performance. To the extent that any residual association remains, it likely reflects non-academic barriers that may hinder these students' ability to persevere in higher education (Ishitani, 2003).

Having attended high school more than 200 kilometers from the University of Atacama is consistently negatively associated with first-to-second-year retention, with students from distant locations having an 8.1 percentage-point lower probability of persisting to the second year compared to their peers living closer to campus. This finding is understandable given the context of the Atacama Region, a northern, sparsely populated area where commuting to campus can be challenging due to the vast distances and limited transportation options. For students living far from the University of Atacama, the daily commute to campus may be impractical or even impossible, requiring relocation or long-distance travel. This geographical barrier can pose significant financial, logistical, and emotional challenges for students, potentially impacting their ability to fully engage with their studies and integrate into the campus community (Wolfe, 1993).

However, having attended high school more than 200 kilometers from the University of Atacama did not correlate with worse progression outcomes, such as failing any courses or failing any fall (first semester) classes. This finding suggests that students from distant locations are not inherently academically disadvantaged compared to their peers living closer to campus, confirming prior literature (Gianoutsos & Rosser, 2014; Ishitani & Reid, 2015). Despite the challenges they may

face in commuting or relocating to attend university, these students appear equally capable of maintaining satisfactory academic progress during their first year.

We utilized sound, comprehensive administrative data from the Chilean Ministry of Education to account for the years elapsed between high school graduation and first-year college enrollment. Prior literature (Adelman, 2006; Bozick & DeLuca, 2005) suggests that a gap between high school graduation and college entry may have a detrimental effect on first-year college success. However, our results strongly suggest an opposite trend. Years since high school graduation shows a consistent and positive association with first-year academic progression, but its relationship with retention is considerably weaker and largely attenuates once early academic performance is accounted for, suggesting that delayed entry influences persistence primarily through its impact on academic momentum rather than through a direct effect on enrollment continuity. This finding suggests that students who delay their college enrollment may exhibit greater maturity and readiness for their studies, which could contribute to better academic performance. The positive association between years since graduation and academic outcomes challenges the notion that a gap between high school and college is necessarily detrimental to student success, at least in the context of a regional public university. Several factors may explain this relationship. Students who take time off before enrolling in college may use that period to gain work experience, explore their interests, or address personal challenges, all of which can foster personal growth and development. Additionally, older students may have a clearer sense of purpose and motivation for pursuing higher education, leading to greater commitment and focus on their studies (Bye et al., 2007).

Beyond background characteristics, our findings underscore the importance of specific progression metrics in predicting retention. Higher GPAs and passing all courses, particularly in the Fall term, significantly increase the likelihood of retention, whereas taking a semester off in the Spring drastically reduces retention. These findings underscore the critical role of early academic success in fostering student persistence (Adelman, 2006, 2009; Tinto, 1993) and highlight the need for targeted interventions to support students who may be struggling in their first year, building upon relatively new evidence suggesting the importance of separating freshman outcomes in fall and spring academic performance (Shields, 2023).

Taken together, these findings suggest that first-year success operates through two partially distinct channels: an academic momentum channel, in which early course performance, particularly in the fall term—structures persistence trajectories, and a structural constraint channel, in which geographic distance and financial aid shape enrollment continuity independent of course performance. The divergence between progression and retention outcomes indicates that institutions optimizing solely for retention metrics may overlook underlying academic fragility.

Implications for Higher Education Policy

These findings carry direct implications for institutional strategy in Chile. Institutions should consider implementing targeted support programs for male students, first-generation students, and students living far from campus to help mitigate the challenges these groups face in academic performance and retention. Additionally, the strong influence of private voucher schools on student success suggests that policymakers should examine these schools' practices and resources to identify strategies that could be adapted to improve outcomes in public schools.

Given the timeliness of potential interventions and the strong association between progression metrics and retention, our results suggest that focusing on students who did not pass all their courses during the fall term is the best option. Simultaneously, our results highlight the importance of better understanding the determinants of students taking the spring term off, whose likelihood of not returning to school in their second-year decreases by a large 47 percentage points.

Moreover, the significance of early academic success in predicting retention highlights the need for institutions to provide robust academic support services, particularly during the first year of college. Strategies such as early alert systems, proactive advising, and peer mentoring programs can help identify and assist struggling students before they fall too far behind (Hably et al., 2012). Given the recent expansion of financial aid programs in Chile (Espinoza et al., 2023), institutions must ensure that these resources effectively support student success and retention.

Implications beyond Chile: Lessons for Latin American Higher Education Systems

Our findings from Chile's early implementation of free tuition carry significant implications for Latin American higher education systems more broadly, many of which are pursuing similar access expansion policies. Recent scholarship on Latin American higher education reforms has documented a regional pattern wherein financial barriers to entry have been progressively reduced through various policy mechanisms—from Colombia's merit-based Ser Pilo Paga program to Brazil's quota systems and Argentina's longstanding public university gratuity—yet equity gaps in completion outcomes persist (Bernasconi & Celis, 2017). Our finding that Chilean tuition beneficiaries show improved retention but not enhanced credit progression echoes concerns raised throughout the region: that access expansion without concomitant investment in academic support infrastructure may increase enrollment without meaningfully improving completion for disadvantaged students. This pattern appears particularly pronounced at regional public universities, which across Latin America enroll disproportionate shares of first-generation, low-income, and geographically dispersed students while operating with constrained resources (Santelices & Celis, 2022). For policymakers throughout the region, our disaggregated analysis of retention versus progression outcomes suggests that tracking enrollment continuity alone provides an incomplete and potentially misleading picture of whether access policies are achieving equity goals.

The temporal dynamics we observe—wherein fall semester performance emerges as the critical predictor of retention and academic momentum—hold particular relevance for Latin American institutions struggling to support diverse student populations with limited resources. Munizaga et al.'s (2018) systematic review of retention research in Latin America and the Caribbean identified the need for more fine-grained analyses of first-year outcomes and institutional interventions calibrated to regional contexts. Our findings respond directly to this call by demonstrating that institutions can optimize limited support investments by concentrating resources on the fall semester, when momentum trajectories solidify. Moreover, the persistence of achievement gaps by high school type, first-generation status, and gender—even under universal free tuition—suggests that Latin American higher education systems cannot rely solely on financial aid reforms to achieve equity. Rather, as student experience research across the region has documented (Santelices & Celis, 2022), institutions must simultaneously address academic preparation disparities, provide culturally responsive advising for first-generation students, develop support systems for commuter populations, and examine gender-specific barriers to engagement. For countries implementing or considering tuition elimination policies—a policy model gaining traction across Latin America—Chile's experience offers a cautionary insight: expanding financial access is a necessary but insufficient condition for equitable degree attainment. Complementary investments in institutional capacity, particularly at regional universities serving disadvantaged populations, appear essential for converting access gains into completion outcomes.

Limitations and Directions for Future Research

While this study offers valuable insights into the factors influencing first-year college progression metrics in Chile, it is not without limitations. The sample is drawn from a single institution, which may limit the generalizability of the findings to other contexts. Additionally, the

study relies on administrative data and does not account for other important factors, such as student motivation, engagement, and social integration, which have been shown to impact academic success and retention (Tinto, 1993).

Future research should seek to replicate these findings across a broader range of institutions in Chile and incorporate additional variables that capture the multidimensional nature of student success, such as course-specific grades and measures of effort and commitment, such as attendance and study time. Qualitative studies exploring the experiences of different student subgroups could also provide a more nuanced understanding of the challenges and opportunities they encounter during their first year of college. As Chile continues to expand access to higher education, it will be increasingly important to understand the factors that promote student success and develop targeted interventions to support students from diverse backgrounds.

In conclusion, this study underscores the importance of considering individual-level factors and specific progression metrics when examining first-year college success in Chile. By identifying the key predictors of academic performance and retention, institutions can develop targeted interventions to support students who may be at risk of struggling or leaving college prematurely. Ultimately, such efforts can improve student outcomes and help ensure that all students have the opportunity to thrive in higher education, regardless of their background or circumstances.

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