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Determinants of timely graduation in Chilean universities

Oscar Espinoza [a], Bruno Corradi [a], Luis González [b], Luis Sandoval [c], Noel McGinn [d] and Yahira Larrondo [c]

aFacultad de Educación y Humanidades, Universidad de Tarapacá, Arica, Chile; bPrograma Interdisciplinario de Investigaciones en Educación (PIIE), Santiago, Chile; cUniversidad Tecnológica Metropolitana, Santiago, Chile; dHarvard Graduate School of Education, Swampscott, MA, USA

ABSTRACT

University graduation in Chile has in recent years become a highly debated topic, stimulated by the low rate of on-time graduation. Today only 16% of all students entering higher education graduate in the time indicated in the study plan. The study uses a discrete time multilevel survival model to analyse the relationship between student's characteristics, field of study, academic progression, and timely graduation. Data were obtained from the academic records of students in an intentional sample of 10 selective Chilean universities. The data covered the first 16 semesters for all students entering in 2010. Academic progression was measured based on completed credits, failed courses and academic load. The results show the significance of course failure. In the Chilean case, those students who failed only one course during their university career were 20% less likely to graduate on time than those who failed none. The lack of opportunity for students to recover quickly from course failure limits the system's ability to improve its on-time graduation rate. Flexibilization of the curriculum, providing alternative course sequences, would be helpful to avoid unnecessary delays in graduation.

Introduction

Especially during the last decade, graduation has been a critical issue in the world's systems of higher education (García de Fanelli and Adrogué 2019; Yue and Fu 2017). A reduction in graduation rates and an increase in the delay of students in finalising their studies have constituted a problem for professional education and training. Reduced graduation rates affect national economies as graduates are key players in development and economic productivity. In addition, an increase in the time elapsed before graduation has negative consequences for students as well as their families. Delays result in higher costs and slow down the process of students' insertion in the labour force (Witteveen and Attewell 2021).

Latin America and in particular Chile have not been immune to this problem. Graduation has become one of the major challenges associated with the expansion of Chile's higher education system over the past 30 years (CNA 2022; UNESCO 2021). The

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main worry has been not just graduation rates, but also the time students take to successfully finish their studies.

Chile has one of the lowest on-time[1] graduation rates of OECD (2019). In fact, only 16% of all students entering higher education graduate in the time indicated in the study plan. This is less than half of the 39% rate observed in other OECD countries (OECD 2019). It should be noted, however, that the difference in completion rates between Chile and other OECD countries drops sharply three years after the time specified in the study plan (67% and 54%, respectively). This suggests that the issue in Chile is not so much the completion rate but rather the time taken to reach that rate.

A series of researches at the international level have tried to identify the factors associated with on-time graduation. Some studies have focused on the role played by contextual factors (García de Fanelli 2015). Others have looked at characteristics of higher education institutions (Kurlaender et al. 2014; Su et al. 2020), such as system finance and curriculum structure. Other studies have addressed the relationship between student-level variables such as socioeconomic status, gender, secondary GPA and university performance and time-to-graduation (Andrews 2018; DesJardins, Ahlburg, and McCall 1999; Lin, Chen, and Borden 2021). Studies report that pre-enrollment variables shrink in significance once student academic performance in the university is considered (Aiken et al. 2020; Da Costa, Souza, and Faria 2018; Gershenfeld, Ward Hood, and Zhan 2016; Raji and Schumacker 2015; Yue and Fu 2017). In fact, university academic performance is one of the more important variables associated with timely graduation.

Not all the prior research carried out in Europe and the United States, however, may apply directly to the Chilean context. The Chilean higher education system differs from those in other countries in terms of its curriculum organisation and in the length and rigidity of specific degree programmes (OECD 2009). The curricular structures have been characterised as 'tunnels', given the frequent requisites that must be completed in order to progress academically (Pey, Durán, and Jorquera 2012). In response to this criticism Chile has since 1990 carried out different efforts to improve and increase the efficiency of the formative processes of its universities. A major example has been the Program to Improve the Quality and Equity of Higher Education (MECESUP – Programa de Mejoramiento de la Calidad y Equidad de la Educación) (Pey and Chauriye 2011). In addition, through the Tuning-Latin America Project, the government of Chile worked with various universities to improve quality (Velázquez 2017). These programmes have in recent years resulted in a set of curriculum innovation projects designed to change the teaching model to one based on competencies. The objective was to make study plans more flexible, create a system of transferable credits, and shorten programme lengths (Bustamante et al. 2017; Sandoval and Ormazábal 2021).

Studies in Europe and the United States have highlighted the importance of academic performance to achieve graduation (Arias and Dehon 2013; DesJardins, Ahlburg, and McCall 2002; Lin, Chen, and Borden 2021). It is not clear if these findings are replicated in the Chilean context, given differences in curriculum structures. Despite increasing national interest in raising the graduation rate and efforts during the past two decades, research has not yet identified accurately the factors related to timely graduation. The objective of this research is to analyse the relationship between students' characteristics, their field of study, academic progression and on-time graduation.

Our results look to provide evidence that contributes to the adoption of effective ways to reduce the time taken to graduate. The variables examined here are related to students, but they also reflect characteristics of the system that can affect academic progress and on-time graduation.

Literature review

In response to the expansion of higher education enrollment, interest has shifted to identification of the factors that contribute to on-time graduation. Thanks to longitudinal analyses based on survival models, it is now possible to identify some of these factors (DesJardins 2003; Singer and Willett 1993). This technique has made it easier to recognise factors related to graduation and the time required to attain it (Aiken et al. 2020; Arias and Dehon 2013; Castro-Montoya et al. 2021). The technique has also made it possible to verify the way relationships change over time (Berzenski 2021; Yue and Fu 2017). Students' individual and family characteristics are among the relevant factors. Other factors are academic history prior to entering the university, students' performance and experiences during their time enrolled (Da Costa, Souza, and Faria 2018; DesJardins, Ahlburg, and McCall 1999; Lin, Chen, and Borden 2021).

Studies have demonstrated that graduation rates are associated with student and family socioeconomic status (Andrews 2018; García de Fanelli 2015; García de Fanelli and Adrogué 2019). These variables also affect graduation rates for females (Arias and Dehon 2013; Castro-Montoya et al. 2021; García de Fanelli 2014). The probability of graduating from the university is also higher for students who had higher levels of performance in secondary school (Gallardo, Molina, and Cordero 2016; Raji and Schumacker 2015). However, the importance of socioeconomic characteristics and academic history prior to university diminishes when variables linked to student performance in the university are taken into account (Aiken et al. 2020; Da Costa, Souza, and Faria 2018, Lassibille & Navarro, 2010; Yue and Fu 2017). This happens because pre-enrollment characteristics affect university performance which in turn contributes to on-time graduation.

In research on the role of university performance, various studies have shown that performance in the first semester and the first year of enrollment is critical for continuation of students in the university (Ameri et al. 2016; Katzkowicz and Arim 2017). A study in a public university in the United States concluded that first semester grades predict the time to graduation of low-income African American students (Gershenfeld, Ward Hood, and Zhan 2016). Using a mixed methodology, Hailikari et al. (2020) found a relationship between the study profile of 1st-year students and time to graduation in Humanities and Law. The profile included measures of motivation, abilities, self-efficacy and time spent on study.

Performance during the first year is not the only factor that affects retention to graduation. Grades and approved credits in the later years over time are critical (Aiken et al. 2020; Berzenski 2021; Yue and Fu 2017). A similar finding was reported for the number of semesters required to reach graduation (Da Costa, Souza, and Faria 2018) and the number of credits accumulated (Lin, Chen, and Borden 2021).

Students' commitment to their programmes is important in addition to academic performance. In the case of the United States, those students who change their major, or delay in choosing one, are less likely to graduate within 6 years (Yue and Fu 2017). Participation in high-impact activities such as internships, mentoring or research

assistantships has a positive impact on graduation. But socio-economic status and secondary GPA have a larger impact (Andrews 2018). Those who return after dropping out are less likely to graduate (DesJardins, Ahlburg, and McCall 2002). Those who combine university studies with outside work take more time to graduate or are less likely to finish (Behr and Theune 2016; Theune 2015). A longitudinal study in Norway found that students who held full-time jobs were less likely to graduate. Working more than 20 hours per week significantly reduced the likelihood of graduation (Hovdhaugen 2015).

Other studies have focused on the institutional factors related to graduation. In the United States, Burns et al. (2019) concluded that programmes that permit secondary students to acquire university credits reduce their time to university graduation. A Chilean university offered students who had failed a course an intensive make-up course that resulted in students rejoining their cohort (McGinn et al. 2020). There is also evidence that differences in times to graduation across disciplines and majors are a function of curriculum structure (DesJardins, Kim, and Rzonca 2003; Hailikari et al. 2020; Lin, Chen, and Borden 2021). A study done at the University of California, Davis, found no relationship between course availability and time to graduation (Kurlaender et al. 2014).

A study comparing South Africa and the United States showed that the specific structure of the study plan had a significant impact on time to graduation (Agrawal et al. 2020). Similar results have prompted efforts in countries like South Africa (Lubbe 2017) and Ecuador (Mendez et al. 2014) to make curricular plans more flexible. In the University of Minnesota researchers found a relationship between the sequence of courses required and time to graduation (Morsy and Karypis 2019).

In Great Britain degree programmes in Tourism have speeded up graduation by changing the flexibility of the curriculum plan (Fidgeon 2010). In countries like Canada (Bendakir and Esma 2006), and Thailand (Bhumichitr et al. 2017) mechanisms have been designed to recommend the courses students should take in order to shorten their time to graduation. A study at one of the campuses of the California State University system (CSU) discovered that the four-year graduation rate could be improved by optimising study plans (Su et al. 2020). Similar results have been achieved in a Colombian university. Changing the curriculum design from its traditional form to one that integrated practice learning from the beginning of university study resulted in fewer dropouts (Vergel et al. 2018). In Argentina graduation rates were improved by raising salaries and increasing the number of professors and non-instructional staff (García de Fanelli 2015).

Methodology

This study is quantitative and longitudinal. The guiding research question was: how are characteristics of students, fields of study, and academic programmes related to on-time graduation? A discrete time multilevel survival model was used (Austin 2017; DesJardins 2003; Singer and Willett 1993). The model, using data from Chilean universities participating in the Uniform Admission System (SUA – Sistema Único de Admisión), compared variables associated with the academic trajectory and on-time graduation.

An intentional sample (Cohen, Manion, and Morrison 2007) of 10 universities was included to represent the SUA. These were invited to participate in 2020 and were chosen based on their degree of selectivity (low, medium, high), geographical location (north, center, south) and whether they were public or private universities. Universities that did

not agree to participate were replaced by another one with similar characteristics. The selected universities supplied, for all students entering in 2010, academic records and demographic information from the first 16 semesters.

Programs of the SUA universities vary in their length. This study included only those programmes from which a student can graduate in 10 semesters. These programmes include about 60% of total enrollment. The sample included 10,604 students of whom 850 (8%) were missing cases. The final sample included 9754 students.

Table 1 shows the composition of total enrollment and enrollment in 10 semester programmes for the 10 universities and for all SUA universities. The chosen sample differs in several ways from the total university population. The sample includes slightly more males than females, more first-generation students, and a smaller number of students who graduated from private universities. The differences are not too large, less than 7%, making it reasonable to consider the sample's universities as representative of all SUA participants. The differences in academic backgrounds are also small, considering that the GPA scale ranges from 1.5 to 8.5.

Variables

The dependent variable is graduation, which takes the value 1 if the student graduated in semester j and 0 if not. Two sets of independent variables were considered taking into account previous research and availability. The first refers to characteristics of students before enrollment in higher education. The second set includes variables associated with the student's trajectory while taking courses.

1. Pre-enrollment in Higher Education.

- Gender (Female 0, Male 1)
- Type of Secondary School (Private, Subsidised, Municipal)
- First-generation status (Neither parent had attended university; scored 0, 1)
- PSU Mathematics Test Score (3.95-8.50)
- PSU Language Test Score (3.58-8.34)

Table 1. Total enrollment and enrollment in 10-semester programmes of sampled universities and total SUA (academic Year 2010).

	Total Enrollment			Enrollment 10 Semester Programs		
	SUA	Sample	Difference	SUA	Sample	Difference
Gender						
Female	47.3	45.1	2.3	55.2	51.3	3.9
First Generation						
No	50.4	43.3	6.8	47.4	40.8	6.5
Type Secondary						
Private	14.7	7.9	6.7	11.9	6.5	5.4
Subsidized Private	50.0	53.0	−3.0	50.2	53.5	−3.3
Municipal	35.3	39.1	−3.7	37.8	40.0	−2.2
	Mean (S.D.)	Mean (S.D.)	Average Difference	Mean (S.D.)	Mean (S.D.)	Average Difference
PSU* MATH	6.10 (0.81)	5.96 (0.69)	0.14	5.93 (0.71)	5.82 (0.60)	0.11
PSU* LANG	6.02 (0.78)	5.87 (0.67)	0.15	5.99 (0.74)	5.86 (0.65)	0.13
Total	49,101	15,254		21,086	9,729	

*PSU (Prueba de Selección Universitaria) was the national higher education admission examination.
Source: Authors´ own elaboration.

2. University Trajectory
    2.1 Academic Performance in the University

    - GPA total* (1.0-7.0)
    - Total courses passed* (0-118)
    - Total courses failed* (0, 1, 2, 3, 4, > 4)

2.2. Academic load. First, a calculation was made for each programme of the average number of courses taken per year by students who had not failed any. This was then used to identify students who had taken fewer, the average number, or more courses.

    - Academic Load Year 1-4 (Low, Medium, High)

2.3. Stopout

    - Total semesters out of university* (0, 1, > 1)

2.4. Program characteristics

    - Field of Study (Administration and Commerce, Agriculture, Art and Architecture, Social Sciences, Law, Education, Humanities, Health, STEM)
    - Type of university (Public, Traditional private)

* Variables with values that change between semesters.

Statistical analysis: discrete time survival analysis

Survival models make it possible to study the time elapsed before an event that has not yet occurred (Tutz and Schmidt 2016). This condition 'has not occurred earlier', assumes that the event, in this case graduation, can only occur once. Specifically, the model treats time in units of semesters.

Discrete time models are useful for analysing longitudinal processes. Unlike regression models, they lose less information. They make it possible to include variables with values that can change in time (DesJardins 2003). In addition, they make it possible to include students who have not yet experienced the event or who dropped out during the period (Singer and Willett 1993). At the end of a given semester, students can continue to the next, abandon the university (temporally or definitively) or graduate. Those who continue studying remain in the data base or risk set, while those who pursue another path are removed.[2] As the final state of those who withdraw is not known, they are considered censored cases. Those who are still enrolled at the end of semester 16 are considered right censored cases (Tutz and Schmidt 2016).

The model relies on a random variable that specifies that the student I graduated in semester j $(T_i = j)$ since s/he has not graduated before $(T_i > j-1)$. But the focus of the study is not on T but instead on the Discrete Time Hazard Function (h_{ij}). This represents the probability that the student i was graduated in semester j since s/he has not graduated before (see equation 1). The analysis estimates the value h_{ij} and its relationship with the covariates. Assuming there is

a set of p covariates $\{Z_1, \ldots, Z_p\}$, the Hazard Function can be parameterised to have a logistic relationship with the covariates and with time (baseline) (Cox 1972, see Equation 2). The temporal baseline is represented by the set of dichotomous variables $\{D_{1ij}, \ldots, D_{Jij}\}$.

$$hij = P(Ti = j|Ti\rangle j - 1) \; j = 1, 2, \ldots j \tag{1}$$

$$ln\left(\frac{h_{ij}}{1 - h_{ij}}\right) = \left(a_1 D_{1ij}I. + a_J D_{Jij}\right) + \left(\beta_1 I + \ldots + \beta_P Z_{Pij}\right) \tag{2}$$

Equation 2 shows that the conditional log odds (logit) that a student i will graduate in semester j, since they have not graduated before, is a linear function of time and the observed heterogeneity of the covariates. The equation does not include an intercept. For each period, the intercept is the coefficient for the temporal base line $(a_1, \ldots, a_J)$. These coefficients as well as those of the covariates can be estimated through maximum likelihood using logistic regression (Austin 2017; Singer and Willett 1993; Tutz and Schmidt 2016).

The model shown in Equation 2 is a generic discrete time survival model. Three assumptions must be checked to obtain the model that will be estimated. The linearity assumption indicates that the vertical displacement in the logit of the hazard by units of difference in each predictor is constant (Singer and Willett 1993). In this study, as this assumption was not met with regard to number of total failed courses, this variable was recategorised as indicated above. The generic model (Equation 2) did not include an error term, as it was assumed that all the heterogeneity between students is captured by the covariates. This is the 'no unobserved heterogeneity' assumption. If this assumption doesn't hold, the results could be biased since those who are most likely to graduate do so in the first semesters, reducing artificially the Hazard Function. A non-parametric base line was chosen to reduce the likelihood that this could occur (Arias and Dehon 2013).

Third, the logic profiles between categories of a variable should differ only by their vertical elevation. In other words, they take the same form but one is higher or lower than another (the proportionality assumption). If a variable does not behave in this way its coefficient should vary over time. In practice, this changing effect is incorporated by adding an interaction between the variable and time ($\beta_{11} Z_{1i1} D_1$ in Equation (3)). Given the difficulty of satisfying this assumption, an effect variable has been added to all the variables, resulting in model (3).

$$ln\left(\frac{h_{ij}}{1 - h_{ij}}\right) = \left(a_1 D_{1ij} + \ldots + a_J D_{Jij}\right) + \left(\beta_{11} Z_{1i1} D_1 + \ldots + \beta_{PJ} Z_{PiJ} D_J\right) \tag{3}$$

It is reasonable to expect that graduation is a similar process within each programme and university. If this is not true, the estimated results can be biased as they do not take the independence of the errors into account. Nesting on program and university was seen as one way to handle this problem (Raudenbush and Bryk 2002). Specifically, a discrete time multilevel survival analysis (Austin 2017) using a random intercept was employed to allow Equation (3)'s intercept to vary between clusters (programme/university). This makes it possible to control interdependence among observations in a given cluster. Altogether the database includes 222 undergraduate programmes and 10 universities.

Finally, it was found that, by using the VIF (variance inflation factor) test, there was no multicollinearity. No variable has a value higher than 10 which makes it reasonable to assume there was no collinearity. The model presented in Equation (3) was estimated using the glmer function of the lme4 package (Bates et al. 2015) of RStudio (R Core Team 2024).

Results

The first step in survival analysis is to calculate the hazard function for the data (Table 2). The table shows the proportion of students graduated in each semester compared to the risk set or total of those still studying. Table 2 shows that the probability of graduation (hazard rate) of those still studying is highest in semesters 10, 12 and 14 (33.2%, 34.2% y 35.8%, respectively).

The relationship between each of the independent variables and the probability of graduation over time was estimated using model (3). The results are presented in Table 3. The interclass correlation (ICC), which corresponds to the proportion of variance explained by the correlation of students in the same cluster, reaches 40% at the pro-gramme level, and 19% for universities.

Table 3 shows that, between semesters 10 to 16, pre-enrollment variables are not highly related to the likelihood of graduation. With respect to gender, men are more likely to graduate in semesters 11 and 15. Women are more likely to graduate in semester 16. The only difference in probability of graduation as a function of type of secondary is in semester 12. In that semester municipal students are less likely to graduate than those who studied in a private secondary. First-generation students graduate at the same time as do those students with more highly educated parents. In relation to the selection tests, no differences in the probability of graduation were observed throughout most of the observation period.

Academic performance in the university does make a difference in terms of graduation. The higher the number of courses passed, the more likely is graduation. There is an even stronger relationship between graduation and cumulative grade point average. Of interest is the total of courses failed during enrollment. All levels are significantly different from the base line, at least for on-time graduation. Those who failed even one course during their time in the university (10 semesters) are less likely to graduate on time than those companions who failed none. Those who failed more than four courses are less likely to complete between semesters 10 and 12.

Table 2. Survival to graduation of students in sample.

Semester	Risk Set	Graduates	Hazard rate
10	5,566	1,847	33.2
11	3,381	558	16.5
12	2,744	938	34.2
13	1,683	330	19.6
14	1,275	456	35.8
15	755	143	18.9
16	560	146	26.1

Source: Authors´ own elaboration.

Table 3. Results of discrete time multilevel survival model: probability of graduation in semester 10–16.

Variable	Semester						
	10	11	12	13	14	15	16
t	−13.454***	−19.632***	−19.842***	−22.839***	−23.513***	−22.947***	−17.009***
Gender (ref = M)							
Male	0.075	0.285*	−0.213	−0.023	0.000	0.722**	−0.687
Type Sec (ref = Private)							
Subsidized	−0.083	−0.381	−0.442	0.020	−0.411	−0.186	1.147
Municipal	−0.190	−0.332	−0.571	−0.212	−0.621	0.097	1.128
First Generation (ref = No)							
Yes	−0.028	0.073	0.135	−0.078	0.117	−0.278	−0.132
PSU MATH	−0.188	−0.041	−0.259*	−0.112	−0.307	−0.180	0.064
PSU LAN	−0.017	0.007	0.048	−0.021	−0.091	0.122	−0.432
Total Passed	0.131***	0.172***	0.145***	0.161***	0.144***	0.142***	0.149***
Total GPA	1.725***	2.150***	3.083***	2.963***	3.930***	2.682***	1.899***
Total Failed (ref = 0)							
1	−0.794***	0.031	0.496	0.332	0.761	0.731	1.886
2	−1.154***	−0.125	−0.215	1.026	0.752	1.105	1.790
3	−1.649***	−0.197	−0.399	0.912	1.208	0.949	2.334
4	−2.136***	−0.558	−0.702*	0.649	0.489	0.325	2.565
>4	−3.040***	−1.189***	−1.087**	0.398	0.803	1.457	2.397
Load 1st Year (ref = Medium)							
Low	0.021	−0.177	−0.336*	0.123	−0.112	−0.150	−0.038
High	0.189	−0.324	0.067	0.296	0.023	−0.887*	0.007
Load 2nd Year (ref = Medium)							
Low	−0.878***	−0.219	−0.402**	−0.396*	−0.225	0.448	−0.200
High	0.095	0.371*	0.155	0.007	0.062	0.483	−0.582
Load 3rd Year (ref = Medium)							
Low	−0.801***	−0.623***	−0.215	−0.365	−0.220	−0.018	−0.508
High	0.255*	−0.152	0.145	0.264	0.027	0.179	−0.349
Load 4th Year (ref = Medium)							
Low	−0.843***	−0.513**	−0.341*	−0.651**	−0.357	0.321	−0.211
High	0.505***	0.025	0.332*	−0.038	−0.034	−0.141	−0.360
Semesters Not Enrolled (ref = 0)							
1	−0.282	−0.508	−0.801**	−0.626*	−1.282***	0.703*	−0.457
>1	−2.514***	0.946*	−2.351***	−3.150***	−2.023***	−0.367	−0.711
Type of Uni (ref = Trad Priv.)							
Public	0.206	0.206	0.206	0.206	0.206	0.206	0.206
Field (ref = Education)							
Social Sciences	1.013*	0.669	1.339**	1.454**	1.898***	0.936	1.021
STEM	0.120	0.447	0.218	0.977*	0.719	1.494**	0.468
Art and Architecture	2.131*	1.497	1.772	3.012**	2.812*	1.296	1.456
Administration and Commerce	1.002	1.309*	0.430	1.344*	0.136	1.321	−0.309
Agriculture	−0.177	−0.052	−0.319	0.791	0.533	−0.025	0.250
Law	0.176	−0.571	−1.652	−0.063	−1.893	−2.408	−3.572*
Humanities	−0.172	1.139	−1.750	1.301	1.089	−10.430	−11.718
Health	0.628	0.359	0.535	1.052	1.221*	1.245	1.463*
N	5,566	3,381	2,744	1,683	1,275	755	560
AIC	10,831			Multilevel	Groups	ICC	
BIC	12,564			University	10	0.19	
−2LL	10377***			Program	213	0.40	
Df	15075						

*p < 0.05; **p < 0.01; ***p < 0.001.
Source: Authors´ own elaboration.

Academic load also is related to graduation. Those who carried a low load during their first four years were less likely to graduate than those who carry an average load. This negative relationship is stronger when the academic load is lighter in the second, third or fourth year. Those who carried a high load also differ from the baseline, being closer to an on-time graduation. The results show that the effect of academic load is greater in later semesters. On-time graduation in the 10th semester is related positively to high academic load in the 3rd and 4th year (Table 3).

Those who withdrew from the university for one or more semesters at any moment in their trajectory have a lower probability of graduating on-time than those who were enrolled continuously. The results also show some differences in graduation by field of study. Those most likely to graduate on time are students in Social Sciences and Art and Architecture with Education least likely.

To represent the importance of failed courses on timely graduation, Figure 1 shows the probability that students have of graduating in semester 10. The Figure shows the number of courses they failed while in college and the field of study of their degree programme.[3] It can be seen that the probability of graduating on time is reduced by almost 20% when students fail only one course, regardless of the field of study. Thus, for example, a student in the field of Humanities who has not failed any course has a 34% probability of graduating on time. This drops to 19% in the case of having failed one
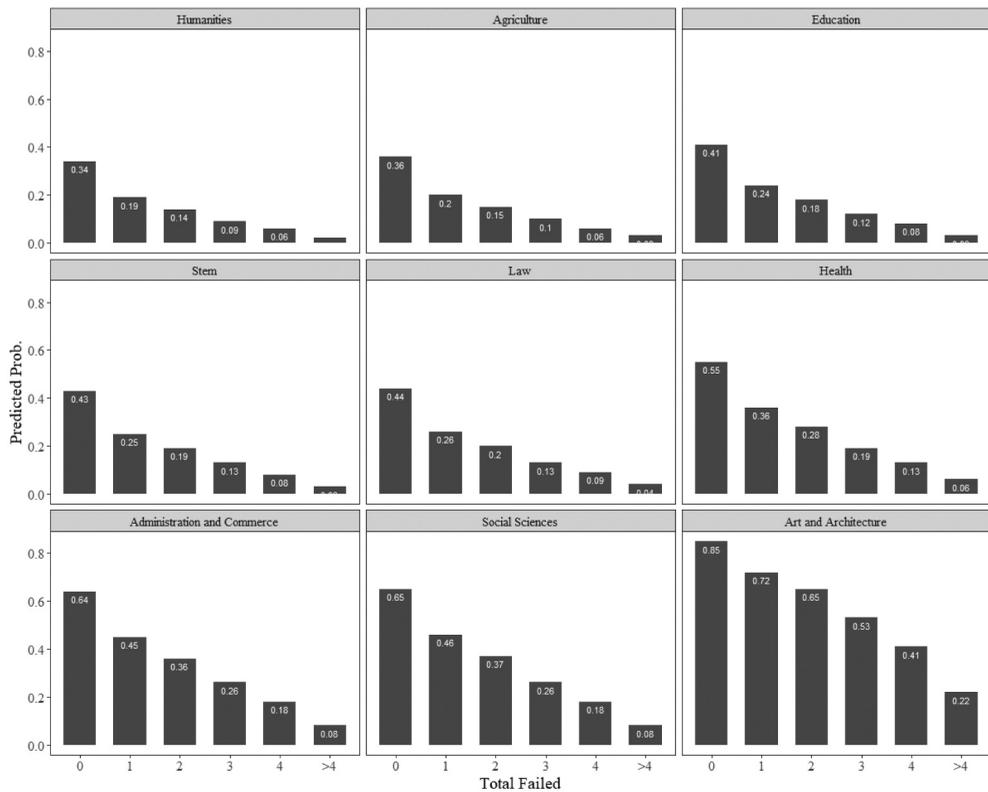

Figure 1. Probability of timely graduation (semester 10) according to number of failed courses and area of knowledge. Source: Authors´ own elaboration.

course. In a similar sense, the figure shows how the probability of timely graduation decreases to a greater extent in the case of more than one failed course.

In addition to the above, it is striking that the probability of timely graduation is less than 50% in the fields of Education, Agriculture, Humanities, STEM and Law. In these fields, even those students who did not fail any course during their stay at the university were not likely to graduate on time.

Discussion

The results show that some pre-university characteristics of students are during most semesters unrelated to the likelihood of graduation. These include the type of secondary school attended and parents' education. These conclusions contradict some previous studies (Castro-Montoya et al. 2021; Gallardo, Molina, and Cordero 2016). They are, however, consistent with studies that show that pre-university characteristics are not powerful predictors of graduation when performance in the university is considered (Da Costa, Souza, and Faria 2018; Lassibille and Navarro 2010). Gender and graduation are significantly related in only some semesters. Note that though overall research reports a higher graduation rate for women (Arias and Dehon 2013; Berzenski 2021; Castro-Montoya et al. 2021), in this study men had higher probabilities of graduation in some semesters.

The academic trajectory once in the university has a clear relationship with graduation. This is in contrast with what pre-enrollment characteristics would suggest. In terms of the field of study, unlike what Lin, Chen, and Borden (2021) reported in Chile, social science students graduate on time to a greater extent than do STEM students. In addition, those who study law programs graduate within the time established by the study plans more than those who study Humanities. This contradicts what Hailikari et al. (2020) found. However, the most salient factors in achieving graduation are related to academic performance and progression such as GPA, academic load during the first four years, completed credits, and failure of courses (Aiken et al. 2020; Berzenski 2021; DesJardins 2003; Raji and Schumacker 2015). Despite these similarities with international research on the importance of academic achievement, Chile has some peculiarities with regard to academic progression. Reports by Aiken et al. (2020), Berzenski (2021) and Yue and Fu (2017) attributed greater importance to the students' choice of major and accumulation of credits. On the contrary, our results show that in Chile academic progression and timely graduation are strongly related to course success. In fact, failing even only one course during 10 semesters in the university reduces the probability of graduating on time by 20%.

A possible explanation for the high significance of course failure in Chile can be the characterisation of the Chilean educational system. In fact, curriculum design underlying study plans is rigid and has long academic programmes (Pey and Chauriye 2011). The impact of long programme duration and negative consequences of course failure is compounded by the failure of the system to provide opportunities for quick recovery. In a significant number of Chilean programmes and institutions, curricular designs continue to be linear, very rigid and with limited options (OECD 2009). Consequently, those who fail a course may see their academic progression delayed.They not only must wait until the following semester to retake the failed course, but they cannot continue with the

courses that follow (Pey, Durán, and Jorquera 2012). As Díaz-Quezada, Poblete, and Gallardo (2019) have reported for the case of a Pedagogy in Mathematics and Computer Science program, some courses are given only once a year. Those who fail them are obligated to lose time waiting. This situation may be similar in many universities and undergraduate programmes.

During the past 20 years, other countries have made efforts to shorten and standardise the study plans of university courses. Among these efforts have been those promoted by the Bologna Process and the Tuning Project. They began in Europe but have extended to other regions including Latin America (González, Wagenaar, and Beneitone 2004).

Chile's move in this direction began at the end of the 1990s with the establishment of the Program to Improve the Quality of Higher Education (MECESUP). Together with the Tuning Project, MECESUP sought to revise the formative programmes of Chilean universities (Pey and Chauriye 2011; Velázquez 2017). In the first decade of the 21st century this meant changes in curriculum (for example, a system of transferable credits) and other ways to validate a student's studies and promote on-time graduation (Bustamante et al. 2017; Sandoval and Ormazábal 2021). Results from these and other studies question whether the effort achieved its purpose (Ferrada 2019). Study plans continue to be too rigid, limiting the ability of those who fail courses to recover in time to graduate with their classmates.

Limitations and future work

All the 10 universities in this study are traditional, i.e. founded before the 1981 reform. However, since 2012, new private universities have joined the centralised admission system (SUA). There is some evidence to think that there may be some differences regarding timely graduation between new private universities and traditional ones (Carpentier, 2021). Therefore, the results of this study should be considered to describe only traditional Chilean universities (private and public), whose curricular designs are less flexible and offer less opportunity to recover from failure of a course.

The initial findings reported here should be complemented and elaborated in future studies. The rigidity of the curricula seems a logical explanation for the impact of failing courses on timely graduation. However, this research did not have any variables to account for it. Future studies could address this limitation by studying how curriculum rigidity affects the academic progression of their students. In addition, more research is needed on the impact of student financial assistance on graduation. This is especially relevant for Chile which in 2016 initiated a programme of free tuition for lower-income students. These and other questions will contribute to a better understanding of the issue, allowing universities to design programmes focused on improving completion of degrees in the country.

Conclusion

This study sought to analyse the relationship between students' characteristics, field of study, academic progression and on-time graduation. On one side, our results confirm international research findings: academic performance and progression are key factors for on-time graduation. On the other hand, the study also shows that unique features

of the Chilean higher education system affect the achievement of timely graduation. Course failure is a highly important factor for academic progression. In Chilean universities, students who fail only one course during their entire university career (10 semesters) are 20% less likely to graduate on time than those who failed none. The factors that influence student progress and especially on-time graduation, depend on the context and the characteristics of the higher education system in which they occur.

The study makes clear that course failure is one of the major problems facing a significant number of the universities in Chile. The lack of opportunity for students to recover quickly from course failure and the rigidity of their study plans constrain the system's ability to improve its on-time graduation rate. The study's results present a challenge to reassess efforts over the last 20 years to improve the university curriculum. Despite the progress made with MECESUP and the Tuning Latin America Project, much remains to be accomplished in the redesign of academic programmes.

The present study's results can be used in various ways to support students and to improve graduation rates in Chilean universities. A first step is to identify students who have failed courses in time to provide remedial programmes that restore them to their on-time trajectory. This is especially important in the case of courses that are prerequisites for other courses in subsequent semesters. In addition, the provision of summer courses can be useful for students to recover their academic progression and not fall behind in their degree.

Secondly, the results indicate that one of the problems of the Chilean university system may lie in the rigidity of its curricula. Universities should therefore maintain and intensify the efforts made to date to make their curricula more flexible. This requires decreasing, where possible, course requirements that make the curriculum excessively sequential. Where it is not possible to eliminate requirements, it is recommended that the most important courses be taught every semester. This would prevent students who fail these courses from being unable to continue their education while waiting for the course to be retaught.

Notes

1. On-time graduation is understood as completion within the time specified in study plans.
2. To avoid bias, dropout should not be correlated with the event of interest (graduation). To test it, a competing risks survival model was estimated, that is, a model with more than one event of interest (dropout and graduation in this case). The results did not vary greatly from those obtained from the simple risk model (a single event of interest, graduation), so we continued with the latter.
3. To calculate these probabilities, the other variables were held constant at the following values: gender = female, type of secondary school = private, First Generation Status = no, mathematics university selection test score = 5.87, language university selection test score = 5.86, total GPA = 4.79, total courses passed = 46, academic load years 1–4 = medium, total semesters out of university = 0, type of university = traditional private.

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ORCID

Oscar Espinoza 🅳 http://orcid.org/0000-0001-7525-2980
Bruno Corradi 🅳 http://orcid.org/0000-0002-4217-0900
Luis González 🅳 http://orcid.org/0000-0003-1850-3899
Luis Sandoval 🅳 http://orcid.org/0000-0002-8988-7888
Noel McGinn 🅳 http://orcid.org/0000-0001-7132-2136
Yahira Larrondo 🅳 http://orcid.org/0000-0002-6057-3586

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