Impact of COVID-19 on higher education: Evidence from Uruguay

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Resumen

El presente trabajo aporta evidencia empírica par Uruguay, sobre los efectos del COVID-19 en el desempeño educativo de los estudiantes de educación universitaria en su primer año de matriculación. Para ello utilizamos datos administrativos de la Universidad de la República desde el 2017 al 2020. Nuestros resultados muestran que los estudiantes matriculados en 2020 tienen mayor probabilidad de abandono y de realizar menos cantidad de cursos, pero son más propensos a obtener mayores calificaciones al compararlos con las cohortes previas. Estos efectos son más pronunciados para los hombres y para estudiantes de menor nivel socioeconómico. Adicionalmente, utilizando datos de una encuesta realizada durante el año 2020, encontramos que la falta de acceso a material bibliográfico, la falta de interacción con estudiantes y docentes y no contar con los recursos adecuados reduce la cantidad de cursos aprobados y está asociado con un puntaje promedio menor de calificaciones. Además, las posibilidades de realizar cursos en cualquier momento, tomar clases desde las casas y evitar los tiempos de viaje aumenta el número de cursos aprobados y las calificaciones obtenidas. Por ultimo, observamos que los estudiantes que se encuentran empleados tienen un peor desempeño al compararlos con los estudiantes que no se encuentran trabajando.

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Abstract

This article provides empirical evidence about the effects of COVID-19 on university students' educational outcomes in the first year of enrollment for a developing country, Uruguay. To do this, we use administrative microdata from the public university students from 2017 to 2020. Our findings show that students enrolled in 2020 are more likely to drop out and take fewer courses but are more prone to obtain larger scores than the previous generations. These effects are more pronounced for males and students from lower socioeconomic backgrounds. In addition, using survey data, we find that the lack of access to bibliographic material, the lack of interaction with teachers and students, and not having adequate resources is associated with a reduction in the number of approved courses, a less average score, and enrollment in fewer courses. Moreover, the possibility of having classes at any time, taking courses from home and avoiding the travelling time increase the number of approved courses and the average score. Finally, we observe that employed students do relatively worse than non-employed students.

Keywords: pandemic, university, educational outcomes

JEL Codes: I23, I24, I25

1. Introduction

The educational system went through significant changes due to the COVID-19 crisis and the suspension of face-to-face lessons. Higher education was not an exception. Studies for developed economies have found that the pandemic positively affected dropout rates (Aucejo et al., 2020, Bulman and Fairlie, 2021) and increased the existing gap between students from different backgrounds (Rodríguez-Planas, 2021). University students face additional challenges in developing countries due to the persistent and significant inequalities mostly related to technological issues (Anderson & Perrin 2018; Vegas 2020; Gonzales 2016, Puckett 2019; Bennett, Maton & Kervin 2009; Palfrey & Gasser 2008, Sleicher 2020). However, the study of the effects of the pandemic in less developed economies on tertiary education students' is still scarce.

In this study, we provide empirical evidence for a developing country, such as Uruguay, regarding the effects of COVID-19 on students' educational outcomes enrolled in the first year of university. We focus on students enrolled in the largest public university in Uruguay, Universidad de la República (UdelaR), covering more than 85% of university students. The UdelaR is a public institution with free access; that is, without tuition fees nor entrance exam tests.

For our purpose, we exploit a rich dataset derived from different administrative record sources from UdelaR, which contains information on first-year enrolled undergraduate students from 2017 to 2020. In particular, these administrative records contain information on students' performance at university and their sociodemographic and socioeconomic characteristics. Overall, using Ordinary Least Square estimations, we compare students' performance enrolled at the university for the first time in 2020 versus their peers enrolled in previous years in which face-to-face classes prevailed. Additionally, we consider the effects of COVID-19 on university students from different socioeconomic backgrounds, analyzing heterogeneous effects according to students' observed characteristics.

We find that the first-year students from the 2020 cohort have a higher probability of dropout when compared to first-year students from previous generations. We also observe that the cohort 2020 took fewer courses and obtained higher average scores in comparison to previous generations. Similar effects are observed when we separately analyze the educational performance by gender for different cohorts of students. However, the effects seem to be more important for boys, showing higher dropout rates and fewer courses taken on average in 2020. We also carry on the analysis for students

from different parental educational backgrounds finding that students with less-educated parents were more affected by the pandemic. In addition, we also perform a different analysis for students who had completed high school in a public institution and those who attended a private one. The results of reduction in activity are observed for both groups of students. However, results for students from private institutions are less negative. This suggests that students from worse socioeconomic backgrounds had suffered more during the pandemic in terms of educational outcomes. Finally, we observe that students from outside the capital of the country, where the university is located, had lower dropout rates suggesting that the online teaching could have helped them to continue studying.

Finally, we use a student survey carried out during the COVID-19 pandemic to understand the channels which could explain the effects found. First, we analyze the correlation between educational performance and the difficulties that students face during this period. We observe that the lack of access to bibliographic material, and the lack of interaction with teachers and with students reduce the number of courses approved. Due to the difficulties in balancing study and work, students enrolled in 1 fewer course, approved on average 1.7 fewer courses, and reduced the average score by 1 point. Moreover, students reporting not having adequate resources do relatively worse; they enroll in fewer courses, approve fewer courses, and obtain less on their average score. Second, we evaluate the correlation between the educational outcomes and students' reported perceptions of the positive aspects derived from changing the teaching modality from face-to-face to online courses. The possibility of having classes at any time increases the number of approved courses and the average score. Furthermore, the possibility of taking the courses from home and not travelling is positively correlated with the number of courses taken and approved. Third, we analyze how labour market participation and care responsibilities at home correlate with observed educational performances. We show that employed students do relatively worse than non-employed students.

Our study relates to the growing literature about the effects of COVID-19 pandemic on tertiary education (Bulman and Fairlie (2021), Aucejo et al. 2020; Rodríguez-Planas 2020; Rodríguez-Planas 2021). These papers find that the pandemic influence in a negative way the enrollment or graduation of students in the United States. In addition, they show important differences by socioeconomic background. We differentiate from this literature in different ways. First, by considering a developing country. As it was mentioned, the effects in less developed economies could be different than developed

economies. Understanding the effects of the pandemic in tertiary education for developing economies is crucial because it could compromise the paths toward economic development. Second, we use administrative records, but as opposed to other papers, our register accounts for an important share of students in the whole population. Moreover, out institutional setting differs from the other papers, by considering the case of a public university with free access.

The rest of the paper is organized as follows. Section two reviews the most relevant literature on this topic. The third section introduces the institutional framework of the Uruguayan university educational system. After describing the sources of information and the empirical strategy followed in section four, section five presents the main results of this study. Al last, section six exposes the outcomes found; the last section presents the final remarks.

2. Literature Review

The economic literature has found negative effects on educational, psychological and labour market outcomes of students derived from the closure of educational centres due to, for example, seasonal and institutional changes, strikes or holidays (Jaume and Willen 2018; Shonkoff and Meisels 2000; Cunha and Heckman 2007; Pischke 2007).

More recently, due to the exogenous shock of COVID-19 worldwide, the literature has focused on the COVID-19 effects on education. For school students, authors have found that COVID-19 increased the existing gap between students from different backgrounds, reduced social mobility, and negatively affected individuals' human capital accumulation (Bacher-Hicks, Goodman and Mulhern, 2020; Chetty et al., 2020, among others).

Bulman and Fairlie (2021) use administrative college-level panel data from all students in the 116-college California Community College system. They found a decrease in the number of enrolled students relative to the prior year, higher for Afro-American and Latin students, first-year students, basic skills courses, and fields such as engineering/industrial technology, education, interdisciplinary studies, and art. Also, they observe lower completion rates and an increase in withdrawal rates and grades. At the same time, Aucejo et al. (2020) survey a sample of 1500 students in one of the largest institutions in the United States and find that COVID-19 has led to delay

graduation by 13%, dropping out of classes by 11%, and change careers by 12%. In addition, around 50% of the sample report a decrease in study hours and in their academic performance. The data also shows that students from low socioeconomic backgrounds are more likely to postpone the decision to graduate.

In addition, Rodríguez-Planas (2020) evaluates the impact of COVID-19 on students' academic performance. Her analysis shows that for a New York University (Queens College), low-income students are 8% more likely to have experienced challenges while attending online classes during spring 2020 than general students at the same college. She also stresses that low-income students report more childcare responsibilities (82% more), lack of internet (49% more), being sick (26% more) or being stressed (12% more). At last, she finds that low-income students were 11% more likely to consider dropping out of a course.

Using data from the same university, Rodríguez-Planas (2021) studies how students from different economic backgrounds and academic pre-COVID performances were differently affected by the COVID-19 pandemic. Her results show that top-performing lower-income students experience a decrease in their GPA (5% less) and earned credits (11% less) during the spring 2020 semester relative to their higher-income peers. The author stresses that this worse performance may be driven by lower-income top-performing students experiencing more significant challenges with online learning than their higher-income peers. In contrast, lower-income and bottom performing students obtained 9% more grading than their higher-income peers in spring 2020 GPA. Plausible explanations provided by the author point to students' concerns with maintaining financial aid.

Before the COVID-19 pandemic, Dettling, Goodman and Smith (2015) found that high-speed internet access generally increased applications to college, but these effects were concentrated among high-income students. Also, Fairlie and London (2012) found some evidence that donating laptops to recently enrolled community-college students improves their educational outcomes. After COVID-19, special attention was paid to differences in socioeconomic backgrounds, which can increase the existing gap between students from different backgrounds, reduce social mobility and individuals' human capital accumulation (Bacher-Hicks, Goodman, Mulhern, 2020; Chetty et al., 2020).

In turn, Kofoed, Gebhart, Gilmore, and Moschitto (2021) randomized students to either an online or in-person class for an Introductory Economics course in a US Military Academy. They found that the shift to online education had negative results on learning. Specifically, final scores for online students dropped by 0.215 standard

deviations, larger for academically at-risk students. A post-course survey finds that online students struggled to concentrate in class and felt less connected to their instructors and peers.

The focus on the study of COVID-19 effects on university students in developing countries is scarce and has the challenge of considering greater inequalities of enrollment into university education due to access and quality to technology and internet connections (Anderson & Perrin 2018; Vegas 2020; Gonzales 2016), inequalities on technology usage abilities in students from different family backgrounds, (Puckett 2019; Bennett, Maton & Kervin 2009; Palfrey & Gasser 2008); and inequalities due to institutional adaptations to the pandemic (Sleicher 2020).

3. The Uruguayan's university institutional educational background

As we mentioned above, we analyze the effects of COVID-19 on educational outcomes in Uruguay. A first distinctive characteristic of the Uruguayan university educational system in comparison to other countries of the region, i.e. Chile, is that education is freely provided; not tuition fees, entrance exam tests, nor limited slots for admissions[1] [2]. The Universidad de la República (UdelaR), is the main public university of the country, which covers 85% of university students and with around 100 undergraduate degrees and more than 200 postgraduate degrees. In 2020, more than 145.000 undergraduate students and more than 10.000 postgraduate students were enrolled at the UdelaR[3]. The second distinctive factor of the Uruguayan public university is that is has been historically located in Montevideo, the capital of the country. Although since 2007 a territorial decentralization process took place by progressively expanding the supply of degree programs in the rest of the country, the percentage of students from Montevideo is still the vast majority (around 85%)[4].

The academic year in Uruguay runs from March to December. Since February, graduated students from high school can enroll in the university; choosing and enrolling on those courses they would like to take within a career. Semester and annual courses coexist depending on the career and in some cases, there is also the possibility of approving the course without attending it; only with an exam. Once courses end (in December), starts an exam period that closes the academic year.

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[1] It is worth noticing that the Uruguayan educational system is public and free in all its levels, since preschool to tertiary education. The share of students from private education at the tertiary level is low.

[2] There are very few careers that are an exception because they have randomly assigned slots to enrolled students. These careers were not considered in the analysis.

[3] Data obtained from the General Planning Office (*Dirección General de Planeamiento*, DGPlan),

[4] Data obtained from the General Planning Office (*Dirección General de Planeamiento*, DGPlan),

The first COVID-19 patient detected in Uruguay was on the 13th of March of 2020; when courses at the university had just begun. For that date the pandemic was already causing alarm around the world. Therefore, by mid-March the university authorities decided to suspend courses for one month at the undergraduate and graduate levels[5]. As in-person classes were suspended for all the academic year in most of the careers provided at the UdelaR, by mid-April virtual classes were implemented[6]. In order to carry on the virtual learning process, the UdelaR used tools previously developed and incorporated new ones[7]. Specifically, 380 virtual teaching rooms were offered, with a capacity for 500-1000 students to be simultaneously connected and attending lessons. By May 2020 virtual tools were widespread and used in all university careers. lso, for students with a lack of access to technological devices, grants and equipment loans were provided to foster students' access to the internet and computers for personal use[8]. The features mentioned before make Uruguay an interesting case of study.

4. Empirical strategy

4.1. Data

To analyze the effect of the COVID-19, we use a novel data set of administrative records from UdelaR for the period 2017 to 2020. We merge different datasets extracted from the administrative system of the university (*Sistema de Gestión Administrativa de la Enseñanza,* SGAE) and provided by the *Dirección General de Planeamiento* (DGPLAN). The first dataset contains information that students report at the beginning of the year, when completing the enrollment form. The fulfillment of this form is compulsory; and comprises students' socioeconomic and sociodemographic characteristics, such as gender, age, place of residence and high school institutional background. The second dataset contains the records of students' academic events, i.e. courses taken, courses approved, and score. This allows us to capture the academic trajectory of students over time.

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[5] It is worth mentioning that in Uruguay the government did not impose the lockdown at any moment of the pandemic. In addition, during 2020 Uruguay did not have a high number of COVID-19 patients neither deaths.

[6] In very few careers, some in person courses were resumed by the end of the second semester. This implied that when the second semester started, courses were still virtual.

[7] Before COVID-19, Udelar had a virtual platform (EVA: Entorno Virtual de Aprendizaje) to be used together with in-person classes but there were significant differences in it use across faculties. During the pandemic, the use of EVA was extended, and in addition other platforms such as Zoom or Teams were used for the online teaching.

[8] A survey conducted at the beginning of the pandemic by the UdelaR showed that 10% of the students did not have a microcomputer (laptop, pc or tablet) to continue with their courses.

Once datasets are merged, we obtain 128.829 students that have enrolled at the UdelaR between 2017 to 2020. We restrict the data to all university students that, over the considered period, meet the following conditions: (i) are enrolled for the first time at the university;[9] (ii) in careers with no changes in their curricula or not limited slots for enrollment; (iii) with more than 100 students enrolled in each year; and (iv) in careers taught all years between 2017 to 2020. As a result, our data contains 59,570 students.

We add to our database two sources of complementary information. First, a self-administered questionnaire collected yearly provides additional information related to students' socioeconomic characteristics such as parental education, parental occupation, students' parenthood, and household members, among others. Although completing this form is compulsory and must be fulfilled before the beginning of the second semester, otherwise the student is not allowed to enroll to second semester' courses; due to the COVID pandemia, this restriction is relaxed in 2020. Therefore, we do not have information from this questionnaire for all students, being that around 12% did not complete the form.

At last, we consider data obtained from a survey carried out by the UdelaR in the last week of June 2020, after the end of the courses of the first semester. This survey aimed to gather information about students' situation during the pandemic and regarding the new modalities of the courses. The survey is representative of all students enrolled at the university, with a stratification design considering the year of admission to the university (distinguishing between the 2020 cohort and previous cohorts). In total, 1.305 students were surveyed; 662 are from the 2020 cohort. We use this data when exploring the potential mechanisms behind our findings.

4.2. Methodology

To estimate the impact of the COVID-19 pandemic on university educational outcomes, we compare first-year enrolled students' performance in 2020 with their peers in previous cohorts. The equation to be estimated is the following:

$$(1) \qquad Y_{i,j,t} = \beta_0 + \beta_1 Pandemia + \gamma' X_{i,t} + \mu_j + \varepsilon_{i,j,t}$$

where $Y_{i,j,t}$ refers to four alternative educational outcomes considered in the analysis for the individual i enrolled in the career j at the year t. The first outcome explored is

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[9] Students may have been enrolled in a different career at the public university in a previous year; thus, not being a 'new' student at the UdelaR.

whether the student did not have any academic activity during the year (*No Activity*). This dummy variable equals 1 if the student did not take any final nor midterm exam during the academic year, and zero otherwise. We identify students with no activity as those who have completed the enrollment form but are not found in the administrative records of academic's activities. The second educational outcome analyzed is the number of courses students signed up for and for which they took at least one evaluation test (*Number of courses*). As third outcome we use the number of approved courses during the year (*Number of approved courses*). We finally consider the average grade of all the exams taken during the year (*Mean Grade*) including the exam period of December 2020.

The key independent variable of this study, *Pandemia*, is a dummy variable that takes the value 1 for year 2020 and 0 for 2017, 2018 and 2019. The coefficient of interest, β_1 captures the effect of the COVID-19 pandemic on different outcomes assuming that the year 2020 would have been similar to previous years if no COVID-19 pandemic would have happened. This is the case if other factors that could affect our educational outcomes are ruled out, such as cohort composition effects. Specifically, and as mentioned above, students' decision on whether to enroll at the university or not was taken before the pandemic appeared in the country, therefore, we should not observe differences in the composition of students across cohorts. In addition, we should observe similar results in the outcome variables before 2020, and a jump in that year. Table A.1 presents evidence in favor of these two points.

We also control for students' characteristics by adding a set of control variables $X_{i,t}$: gender, region of residence, age, high school institutional background, parental occupation; and whether at least one parent has university degree or not[10]; and we include career fixed effects (μ_j).

Equation (1) is estimated without and with full controls obtained from the questionnaire; the former estimation only including the control variables derived from the administrative records. With this last estimation we tackle the possible omitted bias derived from the students that did not have enrollment form; ie students with less activity are more likely to not fulfill the enrollment form.

At last, we explore whether the COVID-19 differently affected students' performance according to different observed individuals' characteristics; by separately estimating

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[10] Table further describes the control variables used in this study.

the equation (1) by students' gender; parental educational background; high school institutional background; and region of birth.

5. Results

5.1 Main estimations

Table 1 reports the annual students' educational outcomes for first-year students under three different specifications: without control variables, with the full set of control variables obtained from merging the administrative records and questionnaire form, and an estimation only with the control variables obtained from the administrative records. Our first finding stresses that the pandemic increased the probability of being enrolled but not taking an exam during the year by around 4 percentage points (pp). This result remains very similar across the alternative specified estimations and could be interpreted as an increase in the dropout rate for first-year university students due to COVID-19.

We second observe that, among the students with at least one activity during the year, the pandemic slightly reduced the number of courses taken in that first year of university; on average, students were enrolled in 0.3 fewer courses than previous generations. We do not find significant differences between the 2020 cohort and previous ones regarding the number of approved courses. However, the 2020 cohort obtained higher scores in comparison to previous generations of around 0.64 points on a scale that goes from 0 to 12. Alternative plausible explanations for this positive effect could point to changes in knowledge evaluations, i.e. more flexible evaluations or less demanding ones; to a selection of students due to the pandemic in which the abler ones remain; or to students putting more effort concentrated in fewer courses taken.

Table 1. Main results

	No Activity			Number of courses			Nº of approved courses			Mean Grade		
2020	0.046**	0.038**	0.044**	0.329*	-0.281*	-0.286*	0.159	0.249	0.218	0.608***	0.699***	0.649***
	(0.020)	(0.015)	(0.019)	(0.165)	(0.158)	(0.161)	(0.186)	(0.183)	(0.183)	(0.211)	(0.214)	(0.207)
p-value	0.027	0.020	0.026	0.054	0.083	0.085	0.399	0.182	0.242	0.007	0.002	0.003
N	59570	40642	57690	51920	37146	50644	51920	37146	50644	44574	32798	43638
Without controls	Yes			Yes			Yes			Yes		
Full controls		Yes			Yes			Yes			Yes	

	No activity			Number of courses			Nº of approved courses			Mean Grade		
Reduced controls	Yes			Yes			Yes			Yes		

Notes: The table reports the OLS estimates for the Pandemic coefficient on the dependent variables indicated in column headings. Robust standard errors clustered at the career level are reported in parentheses. *, **,*** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

5.2 Robustness Checks

One of the main threats to the identification strategy is the possible pre-existing trends in the outcome variables, which confound the effect of the pandemic with other factors not attributable to the shock generated by the advent of COVID-19. That is, conditional on the career fixed effects, and after controlling for variables that can affect performance and could variate over time, the pandemic is assumed to be orthogonal to the error term.

To analyze the extent to which our findings can be attributable to the pandemic or not, we perform two robustness checks. First, instead of using the Pandemic variable, we include a year fixed effect for each year of the considered period; being 2020 the omitted variable. If 2020 is statistically significantly different to previous years, we expect that the estimated coefficients for 2017, 2018 and 2019 should be significant for all the years. Second, the comparison of coefficients between years should be non-different from zero.

Table 2 presents our robustness checks. For the No Activity outcome, students from the 2020 cohort are more prone to not having academic activity during the first year compared to students from each previous generation. In addition, we do not find significant differences in the probability of no academic activity in the first year for 2017 students versus those in 2018; nor for 2018 students versus 2019 ones. Regarding the number of taken courses, we observe that the probability of enrolling in more courses was already lower in 2019 compared to 2018. The estimated coefficients for 2019 are positive but non-significant. The only significant coefficient for the number of approved courses is for 2019. However, we find the same results for the mean score as the one found for No Activity; in 2020 the grades are better than for all the other years, and there are no significant differences between the previous periods.

Table 2. Robustness check including dummy variables for years

	No activity			Number of courses			Nº of approved courses			Mean Grade		
2017	-0.041*	-0.046**	-0.036*	0.419*	0.430*	0.338	-0.053	-0.063	-0.149	-0.626**	-0.714***	-0.682***
	(0.023)	(0.018)	(0.021)	(0.240)	(0.243)	(0.226)	(0.230)	(0.228)	(0.224)	(0.232)	(0.229)	(0.227)

	No Activity			Number of courses			Nº of approved courses			Mean Grade		
p-value	0.082	0.014	0.093	0.089	0.085	0.144	0.820	0.784	0.511	0.011	0.004	0.005
2018	-0.045**	-0.034**	-0.044**	0.479**	0.369*	0.446*	-0.142	-0.302	-0.194	-0.509*	-0.640**	-0.554*
	(0.022)	(0.016)	(0.020)	(0.216)	(0.204)	(0.221)	(0.217)	(0.206)	(0.216)	(0.289)	(0.290)	(0.286)
p-value	0.045	0.044	0.034	0.033	0.079	0.051	0.517	0.152	0.373	0.087	0.034	0.060
2019	-0.052***	-0.034**	-0.050***	0.095	0.049	0.076	-0.278**	-0.375**	-0.309**	-0.688***	-0.743***	-0.710***
	(0.018)	(0.015)	(0.018)	(0.098)	(0.111)	(0.101)	(0.133)	(0.144)	(0.132)	(0.133)	(0.140)	(0.129)
p-value	0.007	0.035	0.008	0.342	0.659	0.455	0.044	0.013	0.025	0.000	0.000	0.000
N	59570	40642	57690	51920	37146	50644	51920	37146	50644	44574	32798	43638
P-value 2017vs2018	0.687	0.158	0.388	0.685	0.708	0.483	0.209	0.008	0.521	0.196	0.401	0.159
P-value 2018vs2019	0.411	0.972	0.394	0.053	0.119	0.074	0.232	0.489	0.336	0.340	0.582	0.412
Without control	Yes			Yes			Yes			Yes		
Full controls		Yes			Yes			Yes			Yes	
Reduced controls			Yes			Yes			Yes			Yes

Notes: The table reports the OLS estimates for the pandemic coefficient on the dependent variables indicated in column headings. Robust standard errors clustered at the career level are reported in parentheses. *, **,*** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

A third robustness check excludes from the analysis those careers with a previous trend in No activity; careers for which we cannot reject the null hypothesis of no differences on the mean of No activity variable by year is zero. By using this subsample of careers, we restrict our dataset to half of the observations considered in the main estimations (approximately 30,000 students). As Table **3**3 shows, the estimated coefficients in this case are larger than the ones presented in Table 1. The probability of not performing activities increases by 10% because of COVID-19. Among the students who carry out activities in these selected careers, we observe that –as previously found– the 2020 cohort enrolled in fewer courses than in previous years and obtained higher average mean scores than those observed in the main estimation. Again, there are no effects of the pandemic on the number of approved courses.

Table 3. Robustness check considering only careers without tendency in No Activity

	No Activity			Number of courses			Nº of approved courses			Mean Grade		
2020	0.100***	0.076***	0.094***	-0.661**	-0.627***	-0.629**	0.327	0.385	0.365	0.819**	0.866**	0.835**

	(0.024)	(0.019)	(0.024)	(0.230)	(0.210)	(0.220)	(0.273)	(0.299)	(0.287)	(0.300)	(0.307)	(0.302)
p-value	0.001	0.001	0.001	0.011	0.008	0.011	0.247	0.215	0.220	0.014	0.012	0.013
N	28499	19561	27690	25067	18033	24495	25067	18033	24495	20098	15022	19756
Without control	Yes			Yes			Yes			Yes		
Full controls		Yes			Yes			Yes			Yes	
Reduced controls			Yes			Yes			Yes			Yes

Notes: The table reports the OLS estimates for the pandemic coefficient on the dependent variables indicated in column headings. Robust standard errors clustered at the career level are reported in parentheses. *, **,*** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

Overall, the previous results provide consistent support to the identification strategy for the variables No activity and Mean Grade. In both cases, a discontinuity is clearly observed in 2020, when the pandemic appeared. Regarding the number of courses taken and approved by the students, the evidence is less clear, since the estimates are not robust, and the coefficients are not always statistically different from the 2020 coefficient.

5.3 Heterogeneous effects

In this section we analyze heterogeneous effects of COVID-19 on students' educational outcomes. First, we consider all the students enrolled for the first time in a certain career, not excluding those who were previously enrolled in another career. Results are shown in Table 4. The No Activity outcome is still around 3pp but less significant than in the main estimation that only considered new generation' university students. Similar patterns are observed for the number of courses taken and for the number of approved courses. The results for the mean grade are similar to the ones obtained for the main estimation in magnitude and significance, showing that the increase in the grades was observed for all students. This analysis is relevant because is showing that in terms of dropout, COVID-19 affected more the students without a previous institutional affiliation with the university.

Table 4. Analysis considering all first-year students of the different careers

	No Activity			Number of courses			Nº of approved courses			Mean Grade		
2020	0.031	0.038**	0.028	-0.253*	-0.241*	-0.213	0.228	0.315*	0.276	0.668***	0.773***	0.695***

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	(0.022)	(0.018)	(0.021)	(0.148)	(0.141)	(0.144)	(0.176)	(0.168)	(0.171)	(0.182)	(0.191)	(0.176)
p-value	0.165	0.040	0.195	0.095	0.096	0.149	0.203	0.068	0.116	0.001	0.000	0.000
N	89692	54771	87348	74361	48542	72766	74361	48542	72766	61696	41849	60511
Without control	Yes			Yes			Yes			Yes		
Full controls		Yes			Yes			Yes			Yes	
Reduced controls			Yes			Yes			Yes			Yes

Notes: The table reports the OLS estimates for the Pandemia coefficient on the dependent variables indicated in column headings. Robust standard errors clustered at the career level are reported in parentheses. *, **,*** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

Table 5 reports the effects of COVID-19 on the alternative educational outcomes after running the estimations separately by students' gender, parental educational background, secondary institutional educational background, and region of birth. Panel a shows the estimated coefficients of students' educational outcomes separately by gender. We first highlight that the COVID affected to both genders of students, although for different educational outcomes. In addition, if we compare the confidence intervals for both groups, they overlap for all the educational outcomes variables. However, when comparing the magnitude of the coefficients, boys do relatively worse in 2020 than in previous years regarding the probability of not reporting any activity. For girls, this result is less significant and half in magnitude. In addition, boys take fewer courses in 2020 than in previous years, while no significant effects of COVID-19 are found for girls. Regarding the number of approved courses and the mean score, in both cases the point estimate is very similar between groups.

Panel b shows disparity across different parental educational backgrounds, comparing those students with both parents without a university degree, and separately those students with at least one parent with university education. Independently of the parental educational background, students in 2020 reduced their activity in comparison to previous cohorts and again the confidence intervals overlap. However, the analysis of the point estimates shows larger effects for students from relative worse-off parental educational background (4.3pp and significant at 99% versus 2.3pp significant at 90%). There are no effects of the pandemic on the number of courses taken, but students from better-off parental backgrounds approved on average more courses in 2020. Regarding the average score obtained during the first year of enrollment, we observe that independently of the parental educational background, students do better in 2020 in comparison to previous generations. This increase seems to be less pronounced for students with less educated parents.

We also consider whether students from different institutional backgrounds have different educational outcomes due to COVID-19 or not. Specifically, we analyze students from a public secondary institution and those from private ones (Panel c). We first note that both groups of students decrease their activity in 2020 in comparison to previous years and that the confidence intervals overlap. However, this effect seems to be more pronounced for students from public institutions. In addition, students from public secondary institutions reduce in approximately 0.3 the number of courses taken during 2020 while no statistically significant effects are found for those students from private institutions in 2020. The opposite occurs when analyzing the number of approved courses: students from private institutions increased the number of approved courses but no effect is found for students from public institutions. Both groups of students improve their mean score in 2020, but the effect is large for private institutions' students. As students in public secondary institutions are mostly from less wealthy family backgrounds in Uruguay, and as previously found that COVID affected relatively more students from worse-off parental educational backgrounds and from public secondary institutions, we can argue that students from lower socioeconomic background could have been relatively more affected by the pandemic.

The analysis of the effects of COVID-19 regarding students' region of birth, also gives interesting results (Panel d in Table 5). We observe that students born in both regions –Montevideo and the rest of the country-, are relatively more likely to not have academic activity in 2020 in comparison to previous years. Although the confidence interval overlaps, the point estimate suggests that this effect is larger for students born in the capital of the country. In addition, the negative effect found for COVID-19 on the number of courses taken is only significant for Montevideo. Regarding the mean score, the effect is positive and of similar magnitude for both regions. These results suggest that students not born in the capital were less affected by COVID-19, and one potential explanation could be related to the fact that classes were online. The virtual learning modality could have benefited these students by allowing them to stay at their places of birth.

Table 5 Educational outcomes by different characteristics of the students

	No Activity	Number of courses	Nº of approved courses	Mean Grade
Panel a. Gender				
Boys				
2020	0.066***	-0.401**	0.156	0.678***

	(0.021)	(0.148)	(0.222)	(0.232)
p-value	0.004	0.010	0.487	0.006
N	21650	18975	18975	15512

Girls				
2020	0.030*	-0.209	0.263	0.638***
	(0.017)	(0.183)	(0.178)	(0.206)
p-value	0.096	0.260	0.147	0.004
N	36040	31669	31669	28126

Panel b. Parental educational background

Without university degree				
2020	0.043**	-0.304	0.283	0.678***
	(0.017)	(0.184)	(0.200)	(0.216)
p-value	0.019	0.106	0.166	0.003
N	40826	37147	37147	32501

With university degree				
2020	0.025*	-0.162	0.293*	0.758***
	(0.014)	(0.111)	(0.150)	(0.185)
p-value	0.081	0.155	0.058	0.000
N	10731	9937	9937	8989

Panel c. Institutional Background

Public Highschool				
2020	0.045**	-0.342*	0.163	0.602***
	(0.020)	(0.183)	(0.190)	(0.217)
p-value	0.031	0.070	0.397	0.009
N	45035	39269	39269	33604

Private highschool				
2020	0.037**	-0.060	0.433**	0.811***
	(0.017)	(0.102)	(0.197)	(0.200)
p-value	0.032	0.557	0.035	0.000
N	12655	11375	11375	10034

Panel d. Place of birth

Capital of the country				
2020	0.058**	-0.342*	0.163	0.602***
	(0.022)	(0.183)	(0.190)	(0.217)
p-value	0.015	0.070	0.397	0.009
N	27042	39269	39269	33604

Rest of the country				
2020	0.031*	-0.255	0.218	0.594***
	(0.016)	(0.184)	(0.174)	(0.216)
p-value	0.069	0.176	0.219	0.009

	N	30648	27195	27195	23966
Reduce controls		x	x	x	x

6. Channels

As large disruptions were caused by COVID-19 we would expect that students in 2020 did worse than previous generations. However, our previous findings show that although students in 2020 reported on average less activity and reduced the number of courses taken, they did not significantly change the number of courses approved while they obtained on average, higher average grade score than previous generations. Alternative plausible explanations stressed in Rodríguez-Planas (2021) for similar results found in her study are: (1) easier evaluation tests and/or more lenient grading, (2) less teacher supervision due to online evaluations that could be leading for instance to greater students' cheating, (3) an improvement in students' learning process, and (4) less opportunity cost of education due to less favourable employment opportunities.

Due to data limitations, we cannot fully address the potential mechanisms pointed out by Rodríguez-Planas (2021). In particular, we are not aware of any university policy aiming to relax evaluation tests or grading, nor we have information on cheating practices systematically implemented by students in online evaluations. However, we can exploit a survey carried out by the UdelaR in 2020 (*Students Survey, COVID-19*), that specifically intended to relieve students' perceptions of the challenges imposed by COVID-19. On the one hand, the pandemic imposed challenges on students' academic performance: online courses implied that new material resources are needed and could lead to difficulties in balancing household tasks, social interactions mostly disappear, and emotional affection derived from isolation and uncertainty could emerge. On the other hand, the new learning modality implemented, that introduced more flexibility and cost reductions, can be seen as opportunities derived from the pandemic. Overall, the survey carried out by the UdelaR reports on these issues.

We begin by analyzing the correlation between educational performance and the difficulties that students face during the pandemic. Variables considered in the analysis are the following: courses timetable overlapping, lack of access to bibliographic material, lack of interaction with other students and teachers, difficulty in combining study and work, overload of educational activities, emotional affectation, difficulties to participate in classes due to connectivity problems, or difficulty due to not having adequate resources. Table 6 shows that the lack of access to bibliographic material reduces in 0.6 the number of courses approved. In turn, the lack of interaction with

teachers is negatively correlated with the number of approved courses (at 0.5) and with the average grade (at 0.5). Lack of physical interaction with other students also reduces the number of taken and approved courses in 0.7 and 0.9 respectively. Due to the difficulties for balancing study and work, students enrolled in 1 less course, approved on average 1.7 less courses, and reduced the average score in 1 point. At last, students reporting not having adequate resources do relatively worse; they enroll in 1.6 less courses, approve an average of 1.6 less courses, and obtain 1.5 points less on their average score.

Table 6. Difficulties faced by students[11]

	Number of subjects approved	Number of subjects enrolled	Average Score	Dropout
Course overlapping	-0.434	-0.184	-0.0540	-0.00891
	(0.442)	(0.428)	(0.340)	(0.0338)
R-squared	0.570	0.690	0.344	0.250
Access to bibliographic material	**-0.568****	-0.191	-0.339	-0.0160
	(0.277)	(0.262)	(0.267)	(0.0157)
R-squared	0.572	0.692	0.348	0.251
Lack of physical interaction with other students	**-0.542***	-0.371	**-0.530****	-0.00143
	(0.298)	(0.261)	**(0.236)**	(0.0160)
R-squared	0.577	0.696	0.354	0.250
Lack of physical interaction with teachers	**-0.867****	**-0.719*****	-0.402	-0.000112
	(0.345)	**(0.230)**	(0.250)	(0.0204)
R-squared	0.572	0.700	0.350	0.250
Difficulties in balancing study and labor	**-1.700*****	**-1.098****	**-0.915****	0.0224
	(0.307)	**(0.465)**	**(0.347)**	(0.0252)
R-squared	0.592	0.692	0.363	0.252
Academic tasks' overload	-0.275	-0.399	-0.126	-0.0132
	(0.394)	(0.313)	(0.290)	(0.0199)
R-squared	0.569	0.693	0.345	0.251
Emotional affection	-0.806	-0.572	-0.544	0.0421
	(0.497)	(0.366)	(0.343)	(0.0267)
R-squared	0.574	0.690	0.352	0.259
Connectivity problems	-0.255	0.0805	-0.326	0.0308
	(0.371)	(0.392)	(0.289)	(0.0202)
R-squared	0.569	0.703	0.348	0.256
Not adequate resources for virtual lessons	**-1.660*****	**-1.688*****	**-1.151*****	0.0131
	(0.470)	**(0.445)**	**(0.410)**	(0.0389)
R-squared	0.581	0.692	0.362	0.250
Observations	367	367	351	378

[11] The number of observations on the regression is 367 (instead 622) because we restrict the analysis to students who continue their studies during the year.

Table 7 reports the relationship between the alternative educational outcomes studied and students' reported perceptions of the positive aspects derived from changing the teaching modality from face-to-face to online courses. Positive aspects that could be identified are the following: being able to participate in courses at any time, being more participant in online courses than in face to face courses, the possibility of taking courses from home, avoiding travel times, increasing collaborative work, and a greater opportunity for self-evaluation.

Our findings are summarized as follow. First, the possibility of having classes at any time increases in 1 the number of approved courses and increases the average score by 0.8 points. Furthermore, the possibility of taking the courses from home is positively correlated with the number of courses taken in 0.6. Finally, the possibility of not travelling increases the number of approved courses by 1.4 and the number of courses in which students enroll by 1.1.

Table 7. Positive aspects of change in educational modality

	No Activity	Number of enrolled courses	Number of approved courses	Average score
Courses at anytime (recorded lessons)	-0.00646	0.554	**1.098***	**0.825***
	(0.0305)	(0.356)	**(0.339)**	**(0.282)**
	0.250	0.692	0.578	0.359
More participation in online courses	-0.00955	0.202	-0.0382	0.00367
	(0.0173)	(0.376)	(0.422)	(0.353)
	0.250	0.691	0.568	0.344
Taking the courses from home (comfort)	0.00578	0.445	**0.649***	0.246
	(0.0218)	(0.365)	**(0.368)**	(0.326)
	0.250	0.692	0.572	0.346
Avoiding travel times	0.0127	**1.071****	**1.399****	0.388
	(0.0222)	**(0.481)**	**(0.528)**	(0.273)
	0.250	0.698	0.582	0.347
Increasing collaborative work	-0.0231	-0.0640	0.168	0.133
	(0.0189)	(0.394)	(0.406)	(0.286)
	0.253	0.69	0.569	0.345
Greater self-evaluation	-0.00352	0.586	**1.009****	0.363
	(0.0158)	(0.486)	**(0.483)**	(0.365)
	0.250	0.694	0.580	0.349
Observations	378	367	367	351

Next, we analyze the extent to which labour market participation and care responsibilities at home correlate with the observed educational performances. To this end, we use the data from the survey carried out in 2020 from the administrative records to account for students' employment status (whether they are employed or not) and their educational performance. Table 8 shows that employed students do relatively worse than non-employed students. The results are similar when using alternative sources of information: the 2020 survey and the administrative records. Specifically, employed students are 0.9 less likely to approve courses and to enroll in courses (on average, 1.1 less) than non-employed students. When using administrative records, we find that employed students obtain a 0.2 lower score than non-working students. Also, the students who are employed are 6pp less likely to have any academic activity.

Table 8. Variables related to labor market and care tasks

	Number of approved courses (survey)	Number of approved courses (administrative records)	Number of enrolled courses (survey)	Number of enrolled courses (administrative records)	Average score (survey)	Average score (adm records)	No activity (survey)	No activity (adm records)
Employed	**-0.871***	**-0.940***	**-1.140***	**-1.087***	-0.258	**-0.228***	0.0460	**0.0615***
	(0.444)	**(0.201)**	**(0.415)**	**(0.266)**	(0.410)	**(0.0731)**	(0.0315)	**(0.0138)**
Observations	398	9,886	398	9,886	372	8,859	427	11,122
R-squared	0.575	0.471	0.680	0.558	0.326	0.189	0.265	0.120
Household work	-0.171		-0.467		-0.545		-0.00185	
	(0.690)		(0.520)		(0.558)		(0.0534)	
Observations	398		398		372		427	
R-squared	0.571		0.673		0.328		0.261	

Finally, in Table 9 we extend the estimated correlations presented above by adding all the independent variables used in Section 5. Overall, the results are similar (in significance and magnitude) to the previous ones presented. Note that, while no significant correlations were found between emotional problems and educational performance, when adding the full set of controls, we observe that having emotional problems during the pandemic increases in 5pp students' probability of not having any academic activity.

Table 9. Estimations with full set of independent control variables

	Number of approved courses	Number of enrolled courses	Average score	Dropout
Course overlapping	-0.169	0.0748	0.216	-0.0216
	(0.509)	(0.444)	(0.391)	(0.0330)
Access bibliographic material	**-0.543***	-0.216	-0.295	-0.0291
	(0.268)	(0.258)	(0.343)	(0.0202)
Lack of physical interaction with other students	0.0663	0.00949	-0.250	-0.0171
	(0.223)	(0.282)	(0.258)	(0.0154)
Lack of physical interaction with teachers	**-0.506***	**-0.390***	-0.131	-0.0117
	(0.269)	**(0.226)**	(0.208)	(0.0188)
Difficulties in balancing study and labor participation	**-1.191***	-0.511	**-0.671***	0.0215
	(0.337)	(0.416)	**(0.365)**	(0.0300)
Academic tasks' overload	-0.147	-0.333	-0.0414	-0.0276
	(0.357)	(0.335)	(0.305)	(0.0203)
Emotional affectation	-0.516	-0.395	-0.338	**0.0473***
	(0.503)	(0.451)	(0.351)	**(0.0237)**
Connectivity problems	0.204	0.496	0.0189	0.0354
	(0.432)	(0.465)	(0.321)	(0.0252)
Not adequate resources for virtually	**-1.695***	**-1.830***	**-1.115****	-0.00556
	(0.589)	**(0.616)**	**(0.424)**	(0.0422)
Courses at anytime	**0.627***	0.215	**0.624****	0.0128
	(0.340)	(0.321)	**(0.290)**	(0.0343)
More participation in online courses	**-0.870****	-0.268	-0.320	-0.00956
	(0.423)	(0.374)	(0.347)	(0.0192)
Taking the courses from home	-0.194	-0.183	-0.0868	-0.000790
	(0.377)	(0.303)	(0.470)	(0.0234)
Avoiding travel times	**1.473****	**1.260****	0.402	0.0152
	(0.661)	**(0.587)**	(0.368)	(0.0222)
Increasing collaborative work	-0.291	-0.331	-0.164	-0.0239
	(0.356)	(0.344)	(0.287)	(0.0167)
Greater self-evaluation	0.748	0.358	0.127	0.00204
	(0.482)	(0.490)	(0.396)	(0.0179)
Market work	0.115	-0.428	0.293	0.0206
	(0.381)	(0.375)	(0.404)	(0.0241)

Homework	0.899	0.269	0.0945	0.0323
	(0.687)	(0.556)	(0.450)	(0.0465)
Constant	2.509	5.527***	5.544***	-0.0836
	(1.687)	(1.912)	(0.884)	(0.162)
Observations	367	367	351	378
R-squared	0.637	0.728	0.402	0.285

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7. Final remarks

The COVID-19 pandemic generated several changes in the educational system worldwide. Uruguay was not the exception; the educational institutions closed, shifting their activities from face-to-face classes to virtual lessons. In this paper, we provide empirical evidence on the impacts of the COVID-19 crisis on students' educational outcomes in the first year of enrollment in the public university in Uruguay. We analyzed the effect of the sanitary crises on students' performance, such as, no activity, number of courses taken, number of approved courses, and average score. Moreover, we explored heterogeneous effects according to students' socioeconomic characteristics.

We found that COVID-19 increases in around 3pp the number of students that in the first year of enrollment in 2020 reported not having activity. Additionally, students in 2020 enrolled in fewer courses than students in previous generations, in around 0.3 on average; but obtained larger average scores in 2020 than previous generations. It should be noted that the estimations provide consistent support to the identification strategy for the variables No activity and Mean Grade. Regarding the number of courses taken by the students, the evidence is less clear.

In turn, we also found disparities in the effects of COVID-19 according to students' specific observed characteristics. In particular, male students, students from relatively worse-off socioeconomic background, and students born in Montevideo, are relatively more affected by the pandemic. Then, policies aiming to reduce the negative effects of COVID-19 on students' educational outcomes should be focused on this particular segment of students.

Finally, we use a *student survey* carried out during *COVID-19,* to understand the channels which could explain the effects found. First, we analyze the correlation between educational performance and the difficulties that students face during the pandemic. We observe that the lack of access to bibliographic material, the lack of interaction with teachers and with students reduce the number of courses approved. Due to the difficulties for balancing study and work, students enrolled in 1 less course, approved on average 1.7 fewer courses, and reduced the average score in 1 point. Moreover, students reporting not having adequate resources do relatively worse; enroll in fewer courses, approve fewer courses, and obtain less on their average score. Second, we evaluate the correlation between the educational outcomes and students' reported perceptions of the positive aspects derived from changing the teaching modality from face-to-face to online courses. The possibility of having classes at any time increases the number of approved courses and the average score. Furthermore, the possibility of taking the courses from home and not traveling are positively correlated with the number of courses taken and approved. Third, we analyze the extent to which labour market participation and care responsibilities at home correlate with the observed educational performances. We show that employed students do relatively worse than non-employed students.

In this study, we contribute with empirical evidence for a developing country, such as Uruguay, regarding the effects of COVID-19 on students' educational outcomes enrolled in the first year of university. The results provide evidence about COVID-19 consequences on tertiary education, and shed light regarding on necessary actions to mitigate the situation.

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Appendix

Table A.1. Definition of control variables

Control Variables	Definition
Gender	Dummy that takes the value 1 for girls.
Region of residence	Region of residence in the previous year of enrollment including 19 administrative regions in the country.
Age	Numerical variable with the age of the student at the enrollment date.
High school institutional background	The types of institutions are: public, private, coursed high school in a foreign country.
Parents with college degree	Dummy equal to 1 if at least one parent has a college degree.
Father's occupation	Father's occupation among these options: public employee, private employee, member of a worker-managed firm, owner of a firm, self-employee, not working.
Mother's occupation	Mother's occupation among these options: public employee, private employee, member of a worker-managed firm, owner of a firm, self-employee, not working.

Before turning to the identification strategy and results, we first present in Table 2 the average, standard deviation and number of observations for the different outcome variables considered in this study, separately for different years of analysis (2017 to 2020).

Table A.2. Outcome variables by cohorts.

	cohort 2017			cohort 2018			cohort 2019			cohort 2020		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
No activity	0,13	0,33	16212	0,12	0,32	17111	0,12	0,32	16855	0,17	0,37	16795
Number of courses (annual)	6,79	4,57	14181	6,94	4,79	15082	6,14	4,06	14904	6,04	4,02	14011
Number of approved courses (annual)	4,64	4,81	14181	4,72	4,96	15082	4,20	4,39	14904	4,48	4,28	14011
Mean grade (annual)	5,31	2,67	12082	5,49	2,72	12684	5,26	2,76	12608	5,95	2,73	11999

Source: Administrative records from the Public University. 2017-2020

Table 3, in turn, presents the descriptive statistics for the control variables for each cohort considered. Note that similarity between groups is observed.

Table A.3. Control variables by cohort

	cohort 2017			cohort 2018			cohort 2019			cohort 2020		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Gender	0,62	0,48	16212	0,62	0,48	17111	0,61	0,49	16855	0,61	0,49	16795
Birth in capital	0,45	0,50	15874	0,46	0,50	16597	0,46	0,50	16302	0,46	0,50	16068
Age	20,93	6,13	16212	21,01	6,28	17111	21,04	6,42	16855	21,18	6,62	16795
Work	0,23	0,42	13892	0,25	0,43	16037	0,23	0,42	15805	0,22	0,41	14581
Parents with university deg.	0,22	0,41	13655	0,21	0,41	15734	0,22	0,41	15378	0,22	0,41	14348
Public highschool inst.	0,76	0,43	16210	0,76	0,43	17111	0,76	0,43	16851	0,77	0,42	16788

Source: Administrative records from the Public University. 2017-2020