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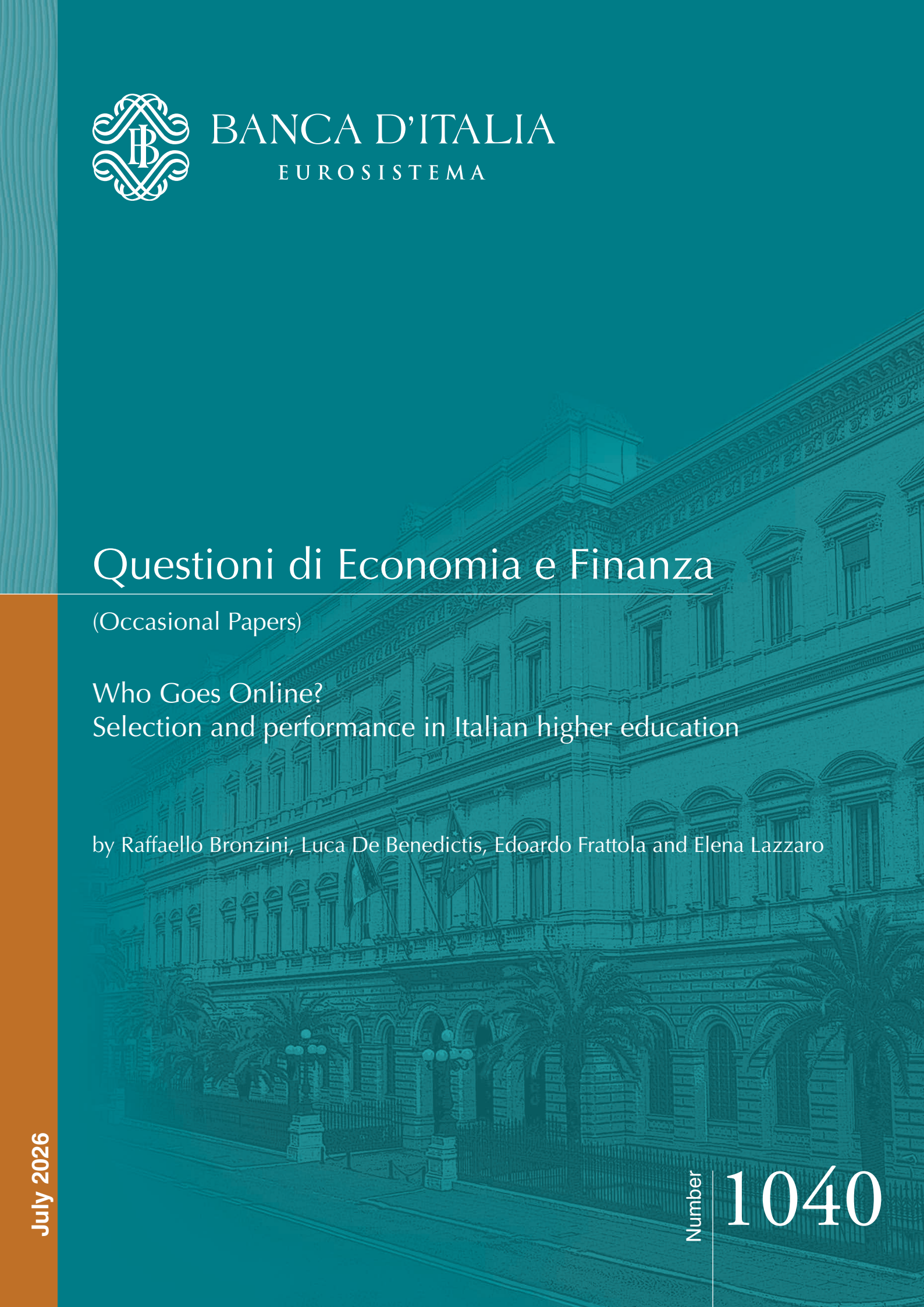

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WHO GOES ONLINE?
SELECTION AND PERFORMANCE IN ITALIAN HIGHER EDUCATION

by Raffaello Bronzini*, Luca De Benedictis**, Edoardo Frattola***
and Elena Lazzaro****

Abstract

Online universities have expanded rapidly in Italy over the past two decades. Leveraging administrative data linked to standardized pre-university test scores, this paper examines the demographic profile and academic outcomes of online students. Compared to their peers in traditional institutions, online enrollees tend to be older, more frequently come from technical or vocational tracks, and have lower high-school grades and standardized test scores. Controlling for these initial disadvantages, they have lower dropout rates and higher on-time completion rates at the bachelor's level. However, performance declines when transitioning from an online bachelor's to a traditional master's degree program. Our findings also suggest that online universities make access to tertiary education viable for individuals who would otherwise be more likely to be excluded: enrollment growth has been concentrated in provinces with historically low participation in higher education and among students with an ex-ante lower likelihood of enrolling.

JEL Classification: I23, I24, J24.

Keywords: online education, higher education access, student performance, educational inequality.

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1 Introduction[1]

The expansion of online higher education has become one of the most visible transformations in university systems. In Italy, fully online universities (*università telematiche*) have grown from a marginal presence in the mid-2000s to account for more than 15 percent of total university enrollment by 2024, corresponding to over 300,000 students. This rapid expansion has generated an intense debate on their role within higher education systems: do online universities widen access by reaching students under-served by traditional institutions, or do they create a parallel and potentially lower-quality track that reinforces existing inequalities?

This debate reflects a broader tension inherent in online education. On the one hand, online universities offer flexibility in time and space, reducing barriers related to geography, employment, family responsibilities, and mobility constraints. These features may be especially valuable in countries such as Italy, where tertiary attainment remains below the OECD average and regional disparities in access to higher education are substantial. On the other hand, critics argue that the same features that make online education accessible may weaken some core dimensions of the university experience, including peer interaction, faculty engagement, and structured learning environments. If so, online institutions may disproportionately attract disadvantaged students while offering them weaker educational returns.

Understanding which of these narratives better describes the Italian case is ultimately an empirical question. This paper addresses it by examining three interconnected issues. First, who enrolls in online universities? Second, how do online students perform relative to comparable students in traditional institutions? Third, does the growth of online universities expand higher education participation or simply substitute for traditional enrollment?

To answer these questions, we combine administrative data on the universe of university enrollments and of high school graduates in Italy, with standardized pre-university test scores from INVALSI, which allow us to observe students' academic preparation before enrollment, as well as their socioeconomic background, together with the complete career of students from high school to university. This data structure makes it possible to study selection into online education with an unusual degree of precision and to interpret subsequent performance differences in light of pre-existing heterogeneity.

[1]For very useful comments and suggestions, we thank Roberto Torrini, Giulia Bovini, Vincenzo Mariani, Francesca Modena, Simone Nobili, Fernanda Gutierrez Amaros and all seminar participants at the Bank of Italy. The views expressed in the paper are those of the authors and do not necessarily reflect those of the Bank of Italy.

Our findings reveal a clear pattern of selection into online universities. Relative to students enrolling in traditional institutions, online students are older, more likely to come from technical and vocational secondary schools, have lower high-school grades, and score substantially lower on standardized tests before university entry. They are also more likely to reside in southern and inner areas, where access to traditional universities is more limited. These patterns indicate that online universities attract a distinct and systematically more disadvantaged student population.

However, conditional on observable characteristics, online students perform better than their traditional counterparts along several dimensions related to persistence. In particular, they are less likely to drop out, less likely to switch degree programs, and more likely to graduate on time. At the same time, they obtain slightly lower graduation grades. This combination of stronger persistence but weaker measured achievement admits several interpretations, which are not necessarily mutually exclusive. On the one hand, it may indicate that online students—who are often constrained by work or family commitments—are more strongly motivated than their peers to complete their degree on time, even at the expense of achieving a lower final grade. On the other hand, these findings may suggest that online universities are particularly effective in reducing barriers to academic persistence and degree completion, or alternatively that they may provide a less demanding (and potentially lower-quality) pathway to tertiary educational attainment.

To further investigate the interpretation of these patterns, we analyze students who complete an online bachelor's degree and then move to a traditional master's program. In this common institutional environment, former online students perform worse than comparable peers from traditional bachelor's programs. This evidence suggests that online universities seem to provide a comparatively lower level of academic preparation.

Finally, we show that the expansion of online universities has occurred primarily in provinces with historically low rates of higher education participation, while enrollment in traditional universities remained broadly stable. This geographic evidence indicates that online universities are not merely reallocating students across institutions, but are bringing new populations into tertiary education. Complementing this macro-level evidence, we also provide micro-level evidence based on predicted individual enrollment probabilities: students who eventually enroll in online universities are disproportionately drawn from the lower tail of the ex-ante distribution of university participation likelihood. In other words, online institutions attract individuals who, based on their observable characteristics, would have been less likely to enter higher education in the first place. Taken together, these findings suggest that the growth of online universities operates mainly along the extensive margin,

expanding participation among students who might otherwise have remained excluded from tertiary education.

These results contribute to several strands of literature. First, they add to research on online higher education by showing that simple comparisons between online and traditional students can be misleading without accounting for substantial selection differences. Second, they contribute to the literature on educational inequality by documenting how online universities create access opportunities for non-traditional students facing multiple constraints. Third, they provide new evidence on the role of geography and latent demand in shaping higher education participation, highlighting the capacity of online institutions to mitigate territorial disparities while activating groups with a lower ex-ante propensity to enroll.

More broadly, our findings contribute to the policy debate on online universities. The relevant question is not only whether online education is equivalent to traditional education in the abstract, but whether it succeeds in reaching students who would otherwise not enroll, and whether it enables them to achieve meaningful academic progression. In the Italian context, our evidence suggests that online universities play an important role in widening participation, although learning outcomes appear to be somewhat lower, broadly confirming previous findings on the effectiveness of fully distance learning. In any case, we do not address long-term labor market returns due to a lack of data; this key question remains open for future research.

The remainder of the paper is organized as follows. Section 2 presents the institutional background and documents aggregate enrollment trends. Section 3 reviews the related literature. Section 4 describes the data and empirical strategy. Section 5 analyzes selection into online universities. Section 6 examines the academic performance of online and traditional students. Section 7 discusses whether the expansion of online universities reflects substitution away from traditional institutions or an expansion of access to higher education. Finally, Section 8 concludes.

2 Institutional Setting and Trends in the European Distance Higher Education Systems

2.1 Italian Online Universities

In Italy, online universities are private (non-state) institutions that deliver degree programs entirely, or almost entirely, through online distance learning.[2] They are regulated by the Ministry of University and Research (MUR) and are subject to the national accreditation system, on a par with traditional universities, albeit with specific provisions tailored to distance education. Online universities must be authorized by MUR, following verification of their structural, organizational, financial, and educational requirements. They are also subject to periodic (five-year) evaluations by ANVUR (*Agenzia Nazionale per la Valutazione dell'Università e della Ricerca*, the Italian National Agency for the Evaluation of the University and Research System) for institutional accreditation, which assess the quality of teaching, research activities, student services, and graduate employment outcomes.

Online universities were established in Italy between 2004 and 2006[3], through a series of laws and decrees that formally recognised their status as higher education institutions equivalent to traditional universities, albeit within a still-developing regulatory framework. In 2021, Ministerial Decree No. 1154 mandated the alignment of online universities with the same quality standards, as well as faculty and student requirements, applied to traditional universities, setting 30 November 2024 as the deadline for compliance verification. At the end of 2024, a decree signed by the Ministry of the University and Research (effective from 1 August 2025) introduced more stringent regulations for distance learning. Notably, at least 20% of teaching activities must be delivered in a non-recorded (i.e. synchronous/live) format, and examinations must be conducted in person, except in cases of emergencies or for students with certified disabilities. The decree also strengthens oversight of student–teacher ratios and the coherence between educational offerings and institutional resources, with the

[2]Some of them are non-state universities participated by public institutions: IUL, Leonardo da Vinci, Uninettuno, Unitelma, Universitas Mercatorum

[3] The *Università Telematica "Guglielmo Marconi"* was recognized by Ministerial Decree of March 1, 2004, followed by the establishment of the *Università Telematica "Leonardo da Vinci"* by Decree of October 27, 2004. In 2005, the *Università Telematica Internazionale "Uninettuno"* was recognized by Decree of April 15, and the *Università Telematica degli Studi IUL* was established by Ministerial Decree of December 2, 2005 (published in the Official Gazette on January 5, 2006). In 2006, several institutions were founded or recognized: the *Università Telematica "e-Campus"* (January 30), the *Università Telematica "Giustino Fortunato"* (April 13, published May 6), the *Università Telematica "Pegaso"* (April 20), the *Università Telematica "San Raffaele"* (May 8), the *Università Telematica "Niccolò Cusano"* (May 10), and the *Università Telematica "Universitas Mercatorum"* (June 12).

aim of mitigating distortions and safeguarding the quality of online degrees.

2.2 Trends in Italian and European Online Higher Education Systems[4]

Italian online universities have experienced remarkable expansion over the last years, reaching a scale comparable to that of the largest traditional higher education institutions. Across the 11 online universities, total enrollment increased from approximately 119,000 students in the 2018/19 academic year to nearly 308,000 in 2024/25, accounting for around 15% of the total student population. Over the same period, the number of graduates rose from about 16,000 in 2018 to nearly 74,000 in 2024 (ANVUR, 2026a). Enrollment is highly concentrated. In 2024/25, the three largest institutions — Università Telematica Pegaso, Universitas Mercatorum, and eCampus — accounted for approximately 72% of the total online student population. The largest institution, Università Telematica Pegaso, now enrolls more students than any Italian university except Sapienza University of Rome.

The number of active degree programs increased from 112 in 2018/19 to 157 in 2024/25, corresponding to a 40% rise. This expansion was particularly pronounced during the pandemic years, followed by a phase of consolidation. From a field perspective, in the 2024/25 academic year, economic, legal, and social sciences accounted for 47% of total students in bachelor's (three-year) degrees (45% of programs offered), a substantially higher share than in traditional universities (32%). These were followed by arts, humanities, and education, which enrolled 21% of students—broadly in line with traditional institutions—and represented 24% of programs. STEM fields accounted for 17% of students (25% of programs), while health and agro-veterinary disciplines enrolled 15% of students despite accounting for only 8% of programs. In both of these areas, the share of students enrolled in online universities is well below the traditional university average, particularly in STEM disciplines; these are also the academic fields that experienced a slower growth from 2019 to 2025, relative to the other disciplinary areas (social sciences and arts and humanities).[5]

The size of the academic workforce has increased significantly during the period. Between 2018 and mid-2025, the number of professors and researchers rose from 454 to 1,239, rep-

[4] In this section, we employ macrodata sourced by the Ministry of University and Research and available up to the 2024/25 academic year, whereas in the rest of the paper our analysis is based on microdata available up to 2020/21 (see Section 4.1 for a description).

[5] If we look at single degree programs, online students are concentrated in sport science (18% of the total online bachelor's enrollments), psychology (15%), management (10%), legal science (11%), and industrial engineering (6%).

resenting an increase of 173%. Despite this substantial expansion, staffing levels remain structurally low relative to enrollments, resulting in very high student-to-faculty ratios in several large institutions. On average, in the academic year 2024/25, the student–staff ratio in the sector was close to 250 students per faculty member (from 261 in 2018/19), far exceeding the levels observed in traditional universities (27.1). Moreover, the share of faculty positions held by fixed-term researchers is relatively moderate (around 40%), indicating a structural reliance on non-permanent staff. Overall, more than half of online universities exhibit structural shortcomings relative to established accreditation standards, especially for high student-to-faculty ratios. These imbalances may raise concerns regarding supervision, the quality of teaching, and related student services (ANVUR, 2026b), even though the demand for human resources may be comparatively lower in online teaching environments.

As regards tuition fees, according to information collected from the Ministry of University and Research, the average annual fees per paying student charged by online universities in the academic year 2023/24 was 2,400 euros.[6] These fees are higher than those charged by traditional public universities, where average tuition amounts to around 1,500 euros; however, the difference is relatively modest. Given the overall high costs faced by non-resident students, comparatively affordable tuition fees may therefore act as a factor driving demand for online universities (McPherson and Bacow, 2015).

The growth in online enrollment, particularly in the aftermath of the pandemic, is not unique to the Italian context, although models of digital and distance learning vary considerably across European higher education systems. In Spain, online students account for approximately 18% of total enrollment within a system comprising several public and private online universities. In the United Kingdom, there is a single large fully online public institution—the Open University—which enrolls around 120,000 students; however, most major traditional universities also offer online or blended (i.e. mixed-mode) programs. In Germany, one large public fully online university coexists with a number of private online institutions. By contrast, in France there are no universities specialized exclusively in distance learning; instead, both public and private institutions collaborate through consortia to deliver online courses via shared digital platforms.

In summary, according to a recent report (Ateneionline, 2026), the proportion of online students does not vary dramatically across European countries, ranging from approximately 9% in Germany to 18% in Spain - figures not distant from the 11% of US according to Deming et al. (2016). However, the Italian system differs markedly from the others in that online

[6] See MUR (2025), *La contribuzione studentesca negli Atenei e negli istituti AFAM nell'anno accademico 2023-2024*, available online.

higher education is concentrated within a distinct group of (almost all) private (i.e., non-state for-profits) universities, largely separated from the rest of the system. In the other main European countries, by contrast, online provision tends to be more hybrid — spanning both public and private institutions — and more closely integrated within traditional universities.

3 Literature review and contributions

Our study intersects with several key strands of academic literature, including selection into online higher education, the effectiveness of distance learning, and the factors affecting educational access.

Closely related to our study is the literature on selection into online education. Evidence from the United States shows that online college students differ from campus-based peers, tending to be older, employed, and having lower level of parental education (Escueta et al., 2020). As regards Italy, Di Santo et al. (2025) recently investigate the characteristics of Italian online universities and their students, using data from the Italian Ministry of University and Research (National Student Registry) and comparing online institutions with traditional ones. The study confirms some evidence reported in ANVUR (2026a) and in prior international research. In particular, students enrolled in online universities tend to be older and to have lower upper-secondary school grades; moreover, there is a higher proportion of students with technical or vocational diplomas (as opposed to academic high school diplomas), as well as a greater share of students residing in Southern Italy.

Geography and work or family commitments are other key factors shaping access to higher education. Research has long shown that proximity to colleges strongly influences enrollment, particularly for students from lower-income backgrounds, with distance acting as a substantial barrier (Card, 1995; Frenette, 2006). Online education may alleviate potential spatial or other types of barriers. Censis (2025) surveys a representative sample of 4,000 graduates from Italian online universities and documents that the majority of students resided in Southern Italy at the time of enrollment. Moreover, approximately 75% of respondents were employed while enrolled, and three-quarters report that the primary motivation for enrolling in an online program was to better reconcile study with work or family commitments, as well as to benefit from greater flexibility in managing personal time.

A substantial body of research examines the effectiveness of online education relative to traditional in-person instruction. Early meta-analyses often found small to moderate negative effects of fully online courses on student learning outcomes (Means et al., 2013;

Cavanaugh et al., 2004), though effects vary considerably by context, course design, and student population.

More recent studies based on large-scale administrative data and experimental designs highlight persistent challenges, including lower persistence and academic performance in online courses. Overall, a substantial body of evidence indicates, by and large, that fully online learning tends to be less effective than traditional in-person learning, using a wide set of measures of academic performance, whereas blended formats—combining in-person and remote components—perform comparably to traditional methods (Xu and Jaggars, 2013; Figlio et al., 2013; Bowen et al., 2014; Brown et al., 2014; Alpert et al., 2016; Bettinger et al., 2017; Escueta et al., 2020; Cacault et al., 2021; Kofoed et al., 2024). Furthermore, Deming et al. (2016) employs an experimental design to assess employers' perceptions of post-secondary degrees, finding that they exhibit a preference for graduates from traditional institutions over those from online institutions.

A related issue concerns whether online universities are more or less efficient than traditional institutions in the provision of higher education. Agasisti and Coppeta (2026) examine this question on Italian traditional public, traditional private and online private universities, assessing the efficiency using a stochastic frontier model, and considering teaching and research as outputs. Their findings indicate that the efficiency of online universities is comparable to that of traditional public institutions and only marginally lower than that of private universities when output is measured solely in terms of teaching (number of graduates). However, when overall efficiency is evaluated—accounting for both teaching and research (number of publications)—a significant gap emerges between online and traditional universities.

Finally, some empirical evidence suggests that access to online courses can improve college completion for non-traditional students and enhance opportunities for rural populations (Hart et al., 2018; Goodman et al., 2019). Our study contributes to this literature by documenting the extent to which fully online universities expand access to higher education.

Relative to existing studies on Italian online universities, our analysis leverages a broader and more comprehensive dataset, combining administrative microdata on high school and university students with standardized measures of competencies from INVALSI assessments. Moreover, we address three related issues. First, we document the characteristics of online students. Second, we examine students' academic performance. Third, we assess the extent to which online institutions facilitate access to higher education for individuals who would otherwise be unlikely to enroll.

4 Data and Empirical Strategy

4.1 Data sources

Our analysis combines administrative data from three main sources: the Italian National Student Registry (*Anagrafe Nazionale degli Studenti*, ANS), provided by the Ministry of University and Research, the universe of high school graduates, collected by the Ministry of Education and Merit, and standardized test data from INVALSI.[7]

The ANS provides comprehensive information on all students enrolled in Italian universities over the period 2010–2021. It includes detailed records on enrollment, academic careers, and outcomes, such as dropout, program switching, graduation timing, and final grades. In addition, the dataset contains individual-level information on demographic characteristics (e.g., gender, citizenship) and geographic location of residence. A key advantage of the ANS data is its full population coverage, which allows us to consistently track both enrollment decisions and academic outcomes across institutions. Information on high-school background, including the year of graduation, type of diploma, and grade at completion, is obtained from the universe of high school graduates collected by the Ministry of Education and Merit.

Notice that, in order to compare academic careers as homogeneous as possible, we focus only on enrollment into bachelor's (three-year) degrees, whereas we exclude from the analysis single-cycle and master's degrees.

We complement these data with information from INVALSI, which provides standardized test scores in mathematics and Italian language administered during secondary education (grade 10), as well as a measure of students' socioeconomic status.[8] These data are available for more recent cohorts only, specifically cohorts graduating from high school since 2015 onwards, and can be matched to ANS records at the individual level. Even if coverage is restricted to a smaller and more selected sample[9] (Table A1), the inclusion of INVALSI allows us to control for pre-university academic ability and family background, two key dimensions

[7] INVALSI is the Italian National Institute for the Evaluation of the Education and Training System. Among its many activities, it is responsible for implementing a standardized test on core skills in Italian and mathematics every year for students in grades 2, 5, 8, 10, and (since the 2018-2019 school year) 13.

[8] The SES (Socio-Economic Status) index is a standardized composite indicator developed by the OECD and adopted by INVALSI to measure students' socio-economic background. The index combines three components derived from student questionnaires: (i) parental education, defined as the highest educational attainment of either parent; (ii) parental occupation, measured as the highest-status occupation according to the International Socio-Economic Index; and (iii) home possessions, capturing both material resources (e.g., computer, own room) and cultural resources (e.g., number of non-school books).

[9] In particular, students with an available INVALSI score are younger, more likely to come from an academic high school and from the Center-North, and tend to show better high-school grades of diploma.

that are otherwise unobserved in administrative university data.

4.2 Descriptive statistics

This section provides a descriptive characterization of bachelor's students enrolling in online universities, focusing on the most recent cohort available in our data (academic year 2021/2022). Taken together, Table A2 and Figures 1 and 2 outline a remarkably coherent profile. The average online student is not a standard school-to-university entrant. Rather, online universities disproportionately attract individuals who enter higher education later in life, after a non-negligible interruption following high-school completion, and who display a weaker academic background already before university entry.

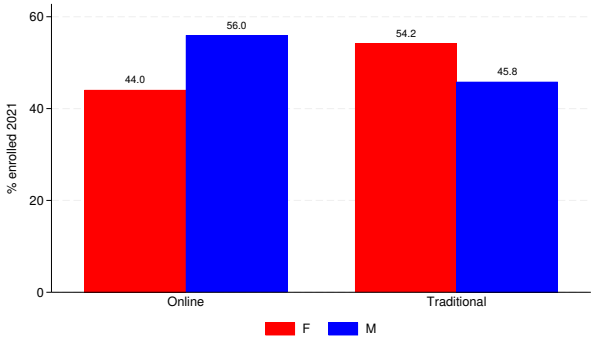
The age distribution is the most immediate and striking piece of evidence. While students in traditional universities are overwhelmingly concentrated around age 19 and 20, the distribution for online students is much more dispersed and shifted toward older ages, with a mean above 27 years, indicating that online enrollment is often chosen well after the end of secondary school. This picture is reinforced by the distribution of the distance from the high-school diploma, which shows that immediate transition to university is the norm among traditional students (82%) but not among online enrollees (only 29%). A substantial share of the latter enter university several years after graduation, and long delays are far from exceptional. This suggests that online universities primarily serve students who do not follow the conventional educational trajectory and instead access tertiary education at a later stage, often after having spent time outside formal education.[10]

This non-standard timing of enrollment is accompanied by a specific geographic profile. Online students are more likely to reside in the South (42% vs. 36% among traditional students) and, albeit to a smaller extent, in inner areas (24% vs. 20%). These differences point to a role of online universities in reducing spatial frictions in access to higher education. The evidence is consistent with the view that online provision is particularly attractive for students living in places where the local supply of traditional university education is less accessible or where participation in higher education has historically been lower. By contrast, differences in citizenship are limited, and gender differences, although present, are not the defining dimension of selection: women are somewhat less represented among online students, but this gap is modest relative to those observed for age or timing of enrollment.

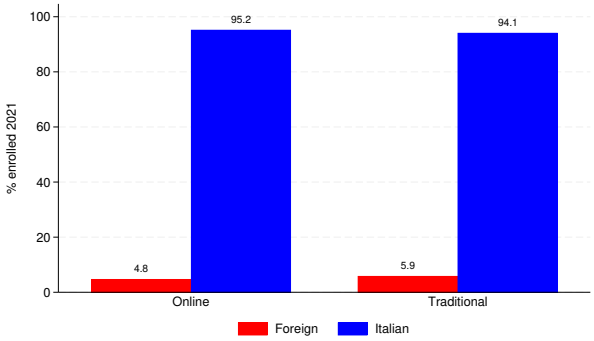
[10] Our data do not allow us to identify the students who are also employed; i.e we cannot observe whether individuals combine study with work. This limitation prevents us from directly identifying working students, although delayed enrollment is commonly interpreted as indicative of prior labor market participation.

Figure 1: **Characteristics of online vs. traditional students: Demographics**

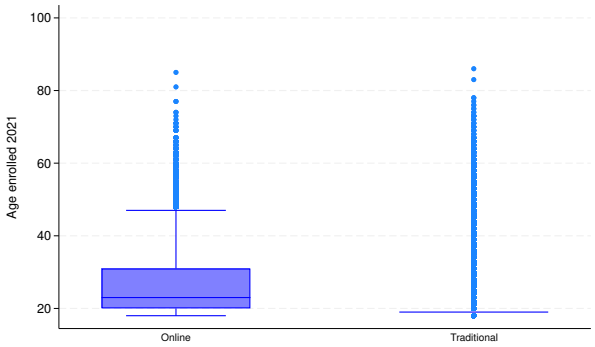
(a) Gender



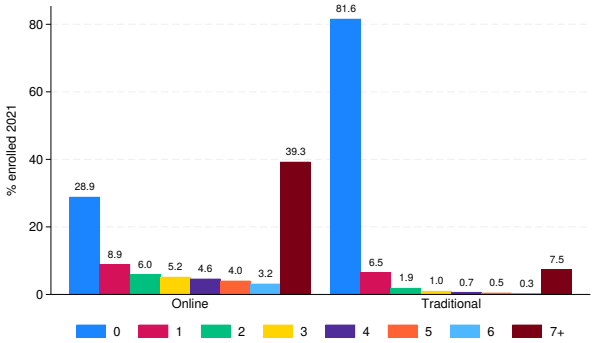
(b) Citizenship



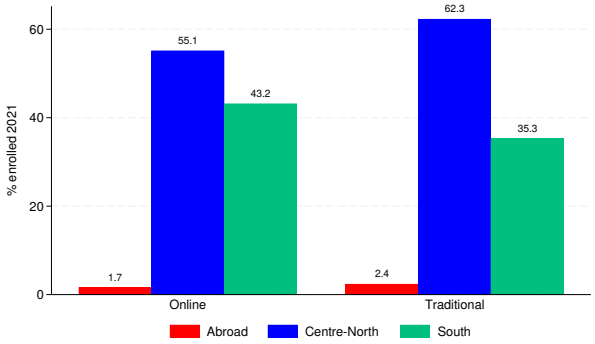
(c) Age at enrollment



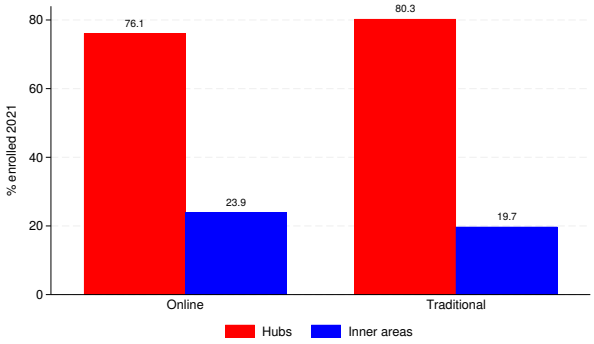
(d) Distance from HS diploma



(e) Area of residency



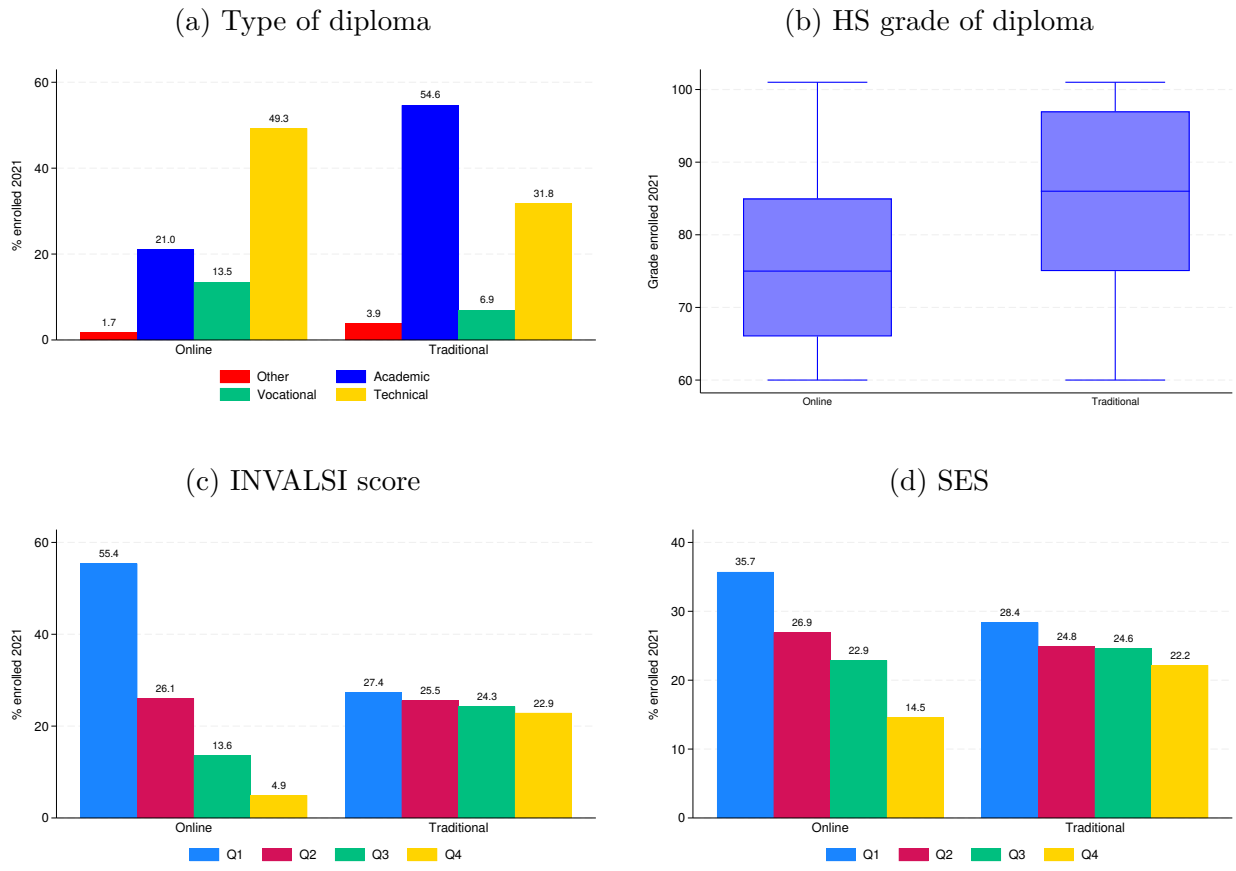
(f) Residency in inner areas



Notes: Data refer to the 2021 enrollment cohort of first-time bachelor's students. HS stands for "high school". The distance between HS diploma and university enrollment (panel c) is measured in years. Source: own elaborations on data from the Ministry of University and Research and the Ministry of Education and Merit.

The contrast becomes even sharper when looking at pre-university educational characteristics. The typical online student is much less likely to come from an academic high-school track (*liceo*, 25% compared to 56% among traditional students) and much more likely to hold

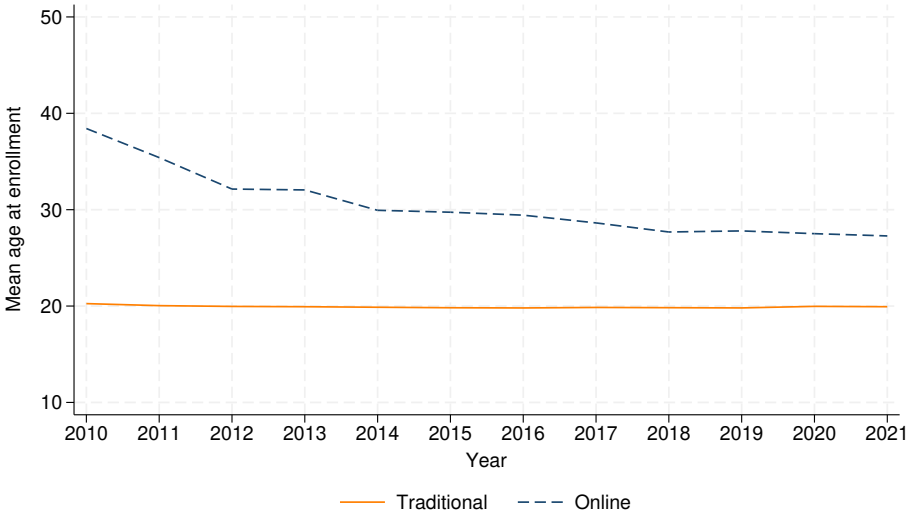
Figure 2: **Characteristics of online vs. traditional students: HS and family background**



Notes: Data refer to the 2021 enrollment cohort of first-time bachelor's students. HS stands for "high school", SES stands for "socioeconomic status". Quartiles of INVALSI score and SES are measured in grade 10. Source: own elaborations on data from the Ministry of University and Research, the Ministry of Education and Merit, and INVALSI.

a technical (58% vs. 33%) or vocational diploma (16% vs. 7%). This is an important difference, as it suggests that online universities attract students whose prior educational pathway is less directly aligned with the traditional academic route into university. Consistent with this pattern, online students also display weaker prior academic achievement. Their distribution of high-school grades (*voto di maturità*) is clearly shifted toward lower values, signaling a lower level of school performance already at the end of secondary education. Standardized test scores reinforce the same message even more strongly. Over half of online students are concentrated in the bottom quartile of INVALSI performance, while their presence in the upper quartiles is much more limited. This indicates that selection into online universities is strongly associated with lower preparation before enrollment. Socioeconomic status also differs, but less markedly. Students from lower-SES families are somewhat more represented among online universities, yet the gradient is noticeably flatter than the one observed for

Figure 3: **Mean age at enrollment over time**



Notes: Data refer to the 2010-2021 enrollment cohorts of first-time bachelor's students. Source: own elaborations on data from the Ministry of University and Research.

academic preparation.

From a longitudinal perspective, Figures 3, A1, and A2 show that age is the only characteristic that has changed meaningfully over time. The average age at enrollment of online students has gradually declined over our period of analysis, indicating that online universities have progressively started to attract somewhat younger cohorts. This is an important development, because it suggests that the expansion of the sector has not been driven exclusively by mature students returning to education, but has increasingly involved individuals closer to the standard university-entry age. At the same time, however, the gap relative to traditional universities has remained large throughout the entire period. Even in the most recent years, online students are on average substantially older than their traditional counterparts.

Overall, the descriptive evidence points to a consistent story. The average student enrolled in an online university is older, enters tertiary education with a delay after high school, is more likely to come from the South or from a peripheral area, and has a weaker academic background, both in terms of secondary-school track and prior performance. Differences in socioeconomic background are present, but they are more limited than those observed for age and academic preparation. This profile suggests that online universities mainly attract students who face a combination of academic and geographic barriers and who are less likely to follow the standard transition from secondary to tertiary education.

4.3 Empirical strategy

We study selection into online universities and subsequent academic performance using a reduced-form empirical approach that conditions on a rich set of observable individual characteristics. The empirical strategy is organized in two parts. We first analyze the determinants of enrollment in online versus traditional universities. We then study differences in academic outcomes across the two groups, conditional on observable characteristics.

To analyze enrollment choices, we estimate the following model:

$$Online_{it} = \alpha + X_i'\beta + \lambda_t + \varepsilon_{it}, \tag{1}$$

where $Online_{it}$ is an indicator equal to one if bachelor's student i enrolls in an online university in year t, and zero otherwise. The vector X_i includes individual characteristics measured prior to enrollment, such as gender, citizenship, and age at enrollment, as well as geographic variables capturing the macro-area of residence and whether the student lives in an inner (peripheral) area. We further include measures of high-school background, namely the type of diploma (academic, technical, or vocational) and the grade of diploma. In specifications where data are available, we augment the set of controls with quartiles of standardized test scores (INVALSI) and of family socioeconomic status. The term λ_t denotes cohort fixed effects, which absorb common time trends in enrollment behavior.

The baseline specification is estimated using a linear probability model (LPM). This choice allows for a straightforward interpretation of coefficients and facilitates the inclusion of multiple fixed effects. To assess the robustness of the results to functional form assumptions, we also estimate a nonlinear logit model and report the corresponding marginal effects in the Appendix.

To study academic performance, we estimate the following model:

$$Y_{ift} = \beta\, Online_i + X_i'\gamma + \lambda_t + \phi_f + \varepsilon_{ift}, \tag{2}$$

where Y_{ift} denotes an academic outcome for student i enrolled in field f and year t. The outcomes considered include dropout between the first and second year after enrollment, program switching within three years, on-time graduation, and final graduation grade, all measured at the bachelor's level. The indicator $Online_i$ captures enrollment in an online university. The vector X_i includes the same set of individual characteristics described above, λ_t are cohort fixed effects, and ϕ_f are field-of-study fixed effects, which account for systematic

differences across disciplines in both student composition and academic outcomes.[11]

The inclusion of a rich set of controls ensures that comparisons between online and traditional students are made conditional on observable characteristics that are known to be strongly correlated with both enrollment choices and academic performance. At the same time, it is important to emphasize that this empirical framework is not designed to identify causal effects of enrolling in an online university. Students self-select into online and traditional institutions based on a combination of observed and unobserved factors, including ability, preferences, constraints, and expectations about future outcomes. While the inclusion of detailed controls—such as high-school background and standardized test scores—helps mitigate concerns related to observable differences, unobserved heterogeneity may still play an important role. As a result, the estimated coefficients should be interpreted as conditional correlations that describe how outcomes differ between online and traditional students with similar observable characteristics. In this sense, the analysis provides a comprehensive descriptive account of selection patterns and performance differences, rather than a causal evaluation of online higher education.

5 Selection into Online Universities

Table 1 reports estimates from a linear probability model of enrollment in online universities. Column (1) uses the full sample of students in cohorts 2010-2021, column (2) restricts to students matched with INVALSI data (a subset of cohorts 2015-2021), and column (3) further focuses on newly graduated high-school students (i.e., those who enroll right after completion of high school) with INVALSI test scores. Across specifications, the results point to a highly consistent pattern of selection, with a small set of characteristics accounting for most of the variation in enrollment choices. The same picture is confirmed in Table A3 using a logit model.

Age at enrollment emerges as an important predictor of enrollment in online universities. In column (1) of Table 1, a one-year increase in age is associated with a 1.6 percentage point higher probability of enrolling in an online institution (relative to a mean of 3.7%). The coefficient is even larger in column (2), where the sample is restricted to students observed in the INVALSI data. By contrast, when restricting the sample to newly graduated high-school students (column (3)), the estimated effect of age becomes much smaller, as age variation

[11] In particular, we classify degree programs into four broad fields: Arts, Humanities and Education; Economics, Law and Social Sciences; STEM; Health and Agro-Veterinary Sciences. By using more granular field fixed-effects, we obtain very similar results.

is mechanically limited within this group, where students enter university immediately after completing secondary education. Taken together, these results indicate that delayed entry into higher education is a central dimension of selection into online universities and that age differences across students play a key role in explaining enrollment patterns in the full population.

Geographic location also plays a relevant role. Students residing in the South are significantly more likely to enroll in online universities, with effects ranging between 0.7 and 2.2 percentage points across specifications. Living in inner areas is also positively associated with online enrollment, although the magnitude of the effect is more modest. These findings are consistent with the descriptive evidence and suggest that online universities partly mitigate spatial barriers to access.

Pre-university educational background is another key dimension of selection. Students with a technical or vocational high-school diploma are significantly more likely to enroll in online universities relative to those from academic tracks. The magnitude of these effects is economically meaningful and remarkably stable across specifications. In parallel, higher high-school grades are associated with a lower probability of online enrollment, indicating that students with stronger academic performance are less likely to choose online universities.

The inclusion of standardized test scores in columns (2) and (3) further sharpens this picture. Relative to students in the lowest quartile, those in higher INVALSI score quartiles are significantly less likely to enroll in online universities, with a somewhat monotonic gradient. This provides strong evidence that prior academic ability is a key determinant of enrollment choices. By contrast, differences in socioeconomic status are more limited. While students from higher SES quartiles are slightly more likely to enroll in online universities, the magnitude of these coefficients is small compared to those associated with academic performance.

Finally, the two groups of students also differ in terms of both gender and citizenship, with women and foreigners being less likely to enroll in online universities.

To complement these results, we implement a LASSO variable selection procedure (Tibshirani, 1996) to rank covariates by predictive power. The selection path shows that age at enrollment is the strongest single predictor, entering first and accounting on its own for about 12 percent of the total reduction in cross-validation error achieved by the full model. Academic ability (lowest INVALSI score quartile) is selected immediately afterwards and provides the largest additional gain, while recent cohort effects (2021 and 2020) and residence in the South also enter early in the path. Taken together, these first five predictors

reduce the cross-validation error from 0.0231 to 0.0221, accounting for roughly 70 percent of the total improvement delivered by the full selected model. High-school track and diploma grade also contribute, but enter later, whereas SES indicators appear only in the final stages of the path, suggesting comparatively limited predictive content once other characteristics are controlled for.

Results are broadly consistent when restricting the sample to students enrolling immediately after high school, but with an important shift in relative importance. In this younger and mechanically more homogeneous subsample, age loses much of its predictive power and enters only later in the selection path, whereas academic ability becomes the leading predictor, followed by cohort effects and prior school achievement (diploma grade and track). Southern residence remains relevant, while SES variables again appear only in later stages. This pattern suggests that age mainly captures life-cycle heterogeneity in the full sample, whereas among standard-age entrants, enrollment choices are more strongly associated with prior academic preparation and cohort-specific demand conditions.

Overall, the regression evidence closely mirrors the descriptive patterns seen in Section 4.2. Selection into online universities is primarily driven by age at enrollment and academic preparation, with additional contributions from geographic factors. Socioeconomic background and other individual characteristics play a comparatively smaller role.

6 Academic Performance

Table 2 reports the relationship between enrollment in online universities and academic outcomes, controlling for a rich set of individual characteristics, as well as cohort and field fixed effects. Four outcomes are considered for bachelor's students: dropout between the first and second year, program switching within three years, on-time graduation, and final graduation grade.[12]

The results reveal a clear and internally consistent pattern. Students enrolled in online universities are significantly less likely to drop out and to switch programs, and substantially more likely to graduate on time. Quantitatively, online enrollment is associated with a reduction in dropout of about 9.8 percentage points and in program switching of 2.7 percent-

[12] To allow for a sufficient time horizon to measure each performance outcome, we can not exploit the most recent enrollment cohorts in our sample. In particular, we focus on the cohorts up to 2019 for dropout and program switching and up to 2018 for on-time graduation and graduation grade. For this reason, we can not even perform any exercise splitting the sample by students enrolled before and after the pandemic. In any case, as a robustness exercise, we have estimated the baseline model excluding the pandemic years (2019/20 and 2020/21), and we have obtained very similar results.

Table 1: **Selection into online universities (LPM)**

	(1) Full sample	(2) INVALSI	(3) New HS graduates
Female	-0.012***	-0.005***	-0.002***
	(0.000)	(0.000)	(0.000)
Italian	0.021***	0.023***	0.004***
	(0.001)	(0.001)	(0.001)
South	0.022***	0.018***	0.007***
	(0.000)	(0.000)	(0.000)
Inner area	0.004***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
Vocational HS	0.020***	0.016***	0.019***
	(0.000)	(0.001)	(0.001)
Technical HS	0.021***	0.011***	0.010***
	(0.000)	(0.000)	(0.000)
HS grade of diploma	-0.001***	-0.000***	-0.001***
	(0.000)	(0.000)	(0.000)
Age at enrollment	0.016***	0.035***	0.003***
	(0.000)	(0.000)	(0.000)
INVALSI score Q2		-0.012***	-0.011***
		(0.000)	(0.000)
INVALSI score Q3		-0.016***	-0.015***
		(0.000)	(0.000)
INVALSI score Q4		-0.016***	-0.016***
		(0.000)	(0.000)
SES Q2		0.005***	0.003***
		(0.000)	(0.000)
SES Q3		0.006***	0.003***
		(0.000)	(0.000)
SES Q4		0.006***	0.003***
		(0.000)	(0.000)
Cohort FE	Yes	Yes	Yes
N. students	2612313	1029421	934081
$\bar{Y}$	0.037	0.024	0.015

Notes: The table reports the β coefficients from Equation (1), estimated through a linear probability model (LPM). Column 1 considers the full sample of first-time bachelor's students enrolled between 2010 and 2021; column 2 considers the subsample of first-time bachelor's students enrolled between 2015 and 2021 who took the INVALSI test in grade 10 between 2012 and 2018; column 3 further restricts the sample of column 2 by considering only students who enroll in the same year they graduate from high school. Standard errors are shown in parentheses. HS stands for "high school", SES stands for "socioeconomic status". $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%.

age points, alongside an increase in the probability of graduating on time of 14.6 percentage points. At the same time, online students obtain slightly lower final grades, with a differ-

ence of about half a point (over a mean of 100 out of 110) relative to traditional students. The same pattern emerges from Tables A4 and A5, which focus on the subsample of students with INVALSI test scores and on newly graduated high-school students, respectively.[13] Taken together, these findings indicate that online students perform better along dimensions related to persistence and completion, but slightly worse in terms of measured academic achievement.

Several mechanisms may rationalize this combination of results. A first explanation relates to flexibility: online programs allow students to better accommodate study with work and other commitments, reducing frictions that typically lead to dropout or delays. A second mechanism is related to motivation: individuals who enroll in online universities — often after a period outside the education system — may be more committed to completing their degree, regardless of the final grade. At the same time, differences in assessment practices across institutions may also play a role. In particular, online programs may adopt evaluation schemes that lower the risk of failing individual exams — through more frequent self-assessment opportunities, multiple visualizations of teaching material, or modularized exams, — thereby facilitating progression through the curriculum without necessarily translating into higher final grades.

6.1 Switchers' Performance

The evidence presented so far raises a natural question. While online students display better outcomes in terms of persistence and completion, these measures do not directly inform us about the level of competencies they acquire. To shed light on this issue, we focus on students who transition between online and traditional universities across degree cycles (*switchers*). In particular, we compare the performance at the master's level of students who obtained a bachelor's degree in an online university and then enroll in a traditional master's program, relative to those who complete both degrees within the traditional system (*stayers*). By construction, this comparison holds constant the institutional environment at the master's level and therefore provides a cleaner assessment of differences in academic preparation.

Before moving to this comparison, we characterize switchers and stayers in the two types of universities. Table A6 reports descriptive statistics for four groups: students who switch from online to traditional universities (O–T), those who remain in online universities (O–O),

[13] The fact that very similar estimates are obtained when restricting the sample to students who enroll immediately after high school suggests that the performance differences between online and traditional universities are not driven exclusively by older students. In other words, we find no evidence of substantial heterogeneity in the estimated effects by age group.

Table 2: **Academic performance (full sample)**

	(1) Dropout	(2) Switch	(3) On-time	(4) Grade
Online	-0.098***	-0.027***	0.146***	-0.549***
	(0.001)	(0.001)	(0.002)	(0.037)
Female	-0.028***	0.006***	0.028***	0.804***
	(0.000)	(0.000)	(0.001)	(0.013)
Italian	-0.022***	0.002**	0.095***	2.211***
	(0.001)	(0.001)	(0.002)	(0.045)
South	0.036***	-0.017***	-0.142***	-0.818***
	(0.000)	(0.000)	(0.001)	(0.013)
Inner area	-0.005***	-0.003***	-0.016***	-0.295***
	(0.001)	(0.000)	(0.001)	(0.016)
Vocational HS	0.158***	-0.016***	-0.207***	-4.732***
	(0.001)	(0.001)	(0.001)	(0.031)
Technical HS	0.085***	-0.012***	-0.114***	-2.770***
	(0.000)	(0.000)	(0.001)	(0.014)
HS grade of diploma	-0.004***	-0.000***	0.012***	0.303***
	(0.000)	(0.000)	(0.000)	(0.001)
Age at enrollment	0.008***	-0.001***	-0.004***	0.149***
	(0.000)	(0.000)	(0.000)	(0.002)
Cohort FE	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes
N. students	2158802	2158837	1914435	1267686
$\bar{Y}$	0.120	0.060	0.353	100.232

Notes: The table reports the estimated β and γ coefficients from Equation (2). To have a sufficient time horizon to measure each performance outcome, columns 1 and 2 consider the full sample of first-time bachelor's students enrolled between 2010 and 2019, while columns 3 and 4 consider those enrolled between 2010 and 2018. Standard errors are shown in parentheses. HS stands for "high school". The omitted category for the type of HS diploma is academic HS. $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%, ** denotes significance at 5%.

those who switch from traditional to online (T–O), and those who remain in traditional universities (T–T). Several patterns emerge. Students who complete both degrees in traditional universities (T–T) appear positively selected in terms of academic background, with a much higher share of academic high-school diplomas and significantly higher high-school grades. By contrast, students who remain in online universities (O–O) display the weakest academic profiles, with a predominance of technical backgrounds and lower high-school grades.

Switchers from online to traditional universities (O–T) occupy an intermediate position. Relative to students who remain in online universities, they have a stronger academic background, with a higher incidence of academic high-school diplomas and slightly better grades, suggesting positive selection into switching. At the same time, they remain negatively se-

lected relative to students who remain in traditional universities. In addition, O–T students are substantially older at enrollment than all other groups, reflecting the non-traditional nature of their educational trajectories. A similar but less pronounced pattern emerges for students switching from traditional to online universities (T–O), who are also somewhat older and exhibit weaker academic characteristics relative to T–T students.

To better interpret our results on performance, we estimate the following regression comparing O-T and T-T students:

$$Y_{ift} = \beta \, OnlineBachelor_i + X_i'\gamma + \lambda_t + \phi_f + \varepsilon_{ift}, \tag{3}$$

where Y_{ift} denotes an academic outcome (on-time graduation or final graduation grade) for traditional master's student i enrolled in field f and year t. The indicator $OnlineBachelor_i$ captures completion of an online bachelor's program. The vector X_i includes the same set of individual characteristics described in Section 4.3, plus bachelor's graduation grade and the distance in years between bachelor's graduation and master's enrollment, while λ_t and ϕ_f are master's cohort and field-of-study fixed effects.

Table 3 reports estimates for this regression. The results indicate that students with an online bachelor's degree perform worse at the master's level along both dimensions considered. They are 4.4 percentage points less likely to graduate on time and obtain final grades that are about 1.5 points lower, even after controlling for our rich set of individual characteristics.[14] These findings suggest that online learning may have adverse effects on the accumulation of competencies. While the estimated differences are not large in magnitude, they should be interpreted as conservative estimates: students who switch from online bachelor's programs to traditional master's programs are positively selected relative to the average online graduate, implying that the true preparation gap is likely to be larger.

Taken together, the evidence reported in Tables 2 and 3 points to a clear trade-off in the evaluation of online universities. On the one hand, these institutions appear to promote persistence and timely degree completion, helping students progress through their studies more smoothly and graduate faster. On the other hand, they seem to provide a comparatively lower level of academic preparation, as reflected in weaker performance when students are later assessed under common standards within traditional master's programs.

[14] Results are robust to an alternative specification that includes an interaction between the bachelor's final grade and the type of bachelor's degree, allowing for potentially different predictive content of this grade across the two university systems. The estimated effect of online degrees remains unchanged and the interaction term is not statistically significant.

Table 3: **Academic performance: Traditional master, switchers vs. stayers**

	(1) On-time	(2) Grade
Online bachelor (Switcher)	-0.044**	-1.515***
	(0.017)	(0.174)
Female	0.033***	0.394***
	(0.002)	(0.014)
Italian	0.109***	1.269***
	(0.006)	(0.063)
South	-0.067***	0.197***
	(0.002)	(0.015)
Inner area	-0.020***	0.043**
	(0.002)	(0.018)
Vocational HS	-0.043***	-0.805***
	(0.005)	(0.047)
Technical HS	-0.043***	-0.396***
	(0.002)	(0.017)
HS grade of diploma	0.002***	0.023***
	(0.000)	(0.001)
Age at enrollment	-0.008***	-0.111***
	(0.000)	(0.004)
Bachelor's grade	0.009***	0.289***
	(0.000)	(0.001)
Years from bachelor to master	-0.032***	-0.053***
	(0.001)	(0.014)
Master's cohort FE	Yes	Yes
Master's field FE	Yes	Yes
N. students	415423	370845
$\bar{Y}$	0.604	107.682

Notes: The table reports the estimated β and γ coefficients from Equation (3). To have a sufficient time horizon to measure each performance outcome, both columns consider the subsample of students who started a traditional master's program between 2013 and 2018 (i.e., first-time bachelor's students enrolled between 2010 and 2015). Standard errors are shown in parentheses. HS stands for "high school". The omitted category for the type of HS diploma is academic HS. $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%, ** denotes significance at 5%.

7 Online and Traditional Universities: Complements or Substitutes?

Another key question is whether the expansion of online universities reflects substitution away from traditional institutions or an expansion of access to higher education. In this section, we provide suggestive evidence along both a macro and a micro dimension.

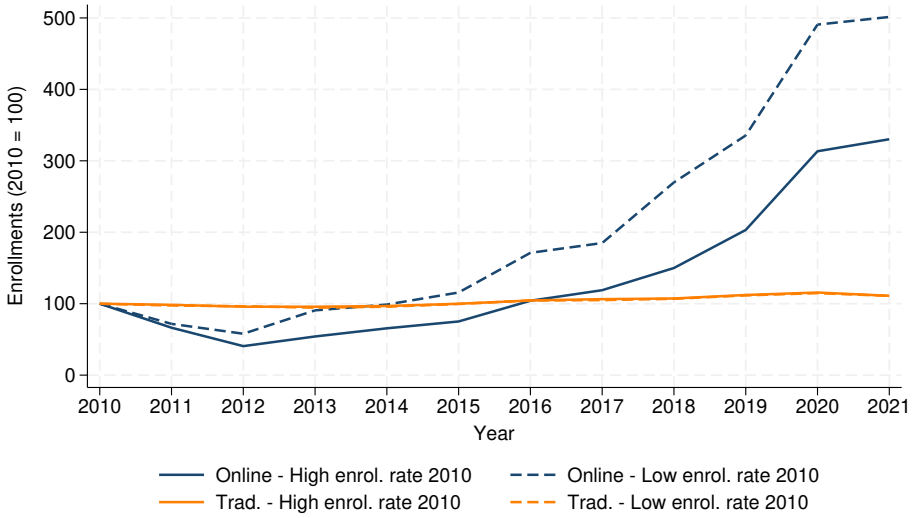
We begin with aggregate patterns. Figure 4 compares the evolution of online enrollments across areas with different initial levels of university participation as measured by the provincial-level share of individuals aged 19 enrolled in university in 2010. A clear pattern emerges: the growth of online universities in the following decade is much stronger in areas that initially exhibited lower enrollment rates (below the median), while no heterogeneity is detected for traditional universities. This suggests that online universities have become more prevalent where access to higher education was historically limited, consistent with an expansion of the extensive margin rather than a simple reallocation of students across institutions.

We then turn to micro-level evidence. Figure 5 reports the distribution of the ex-ante predicted probability of university enrollment for students who eventually enroll in online versus traditional universities. This probability is estimated based on individual characteristics observed prior to enrollment, capturing the likelihood of attending university absent the choice of institution type. In particular, we estimate it by fitting a logit model on the population of high-school graduates (cohorts 2015-2021) who took an INVALSI test in grade 10 between 2012 and 2018. The dependent variable is an indicator equal to one if the individual enrolls in a traditional university (but results are the same if we consider enrollment in any type of university). Covariates include gender, citizenship, macro-area of residence, final high-school grade, type of diploma, year of graduation, standardized INVALSI test scores, and socioeconomic status quartiles. Using the estimated coefficients, we compute for each individual the predicted probability of enrollment based solely on pre-determined characteristics, which we interpret as the expected (ex ante) probability of enrolling in university.

The distribution for online students is clearly shifted to the left relative to that of traditional students. This indicates that individuals who enroll in online universities are, on average, less likely to attend university ex ante. In other words, online universities disproportionately attract students with a lower predicted probability of enrollment, who would be less likely to enter higher education in the absence of this option. Formally, we test the equality of the two distributions using a Kolmogorov-Smirnov test, which strongly rejects the null hypothesis that the distributions are the same.

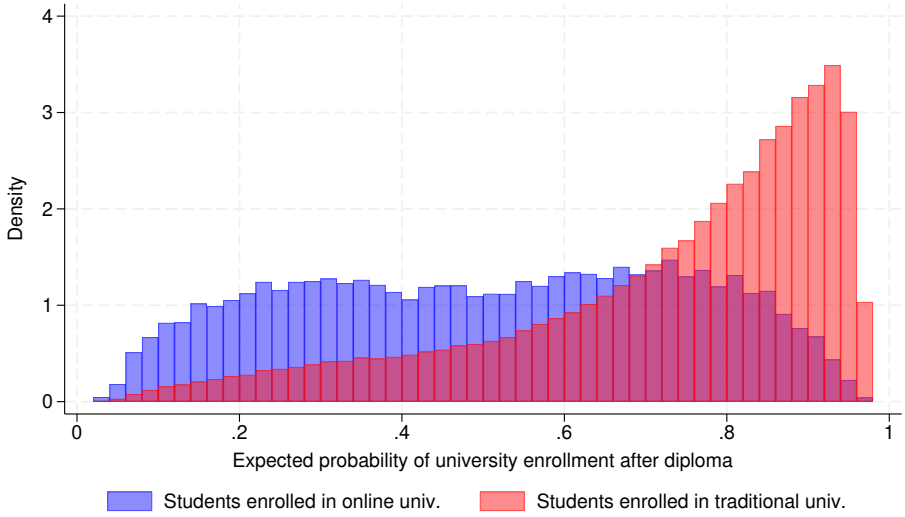
Taken together, the macro and micro evidence point in the same direction. The expansion of online universities appears to be associated with an increase in participation among individuals who are less likely to enroll in traditional universities, suggesting that online institutions act, at least in part, as a complement rather than a substitute to the existing higher education system.

Figure 4: **Online enrollments in areas with high vs. low initial enrollment rate**



Notes: The figure shows the evolution of enrollments in online (blue lines) and traditional (orange lines) bachelor's degree programs among students living in provinces characterized by an initial enrollment rate above (solid lines) vs. below (dashed lines) the national median. The initial enrollment rate is measured as the provincial-level share of 19-year-old residents who enrolled in university in 2010. Source: own elaborations on data from Istat and the Ministry of University and Research.

Figure 5: **Distribution of ex-ante predicted probability of university enrollment for students eventually enrolled in online vs. traditional universities**



Notes: The figure shows the distribution of the ex-ante predicted probability of university enrollment for students who eventually enrolled in online (blue bars) versus traditional (red bars) universities. The estimation procedure is described in footnote 4. Source: own elaborations on data from the Ministry of University and Research and the Ministry of Education and Merit.

8 Conclusions

This paper studies who enrolls in online universities and how they perform, using comprehensive administrative data on university students in Italy. The analysis provides a consistent picture along three dimensions: selection, academic performance, and the role of online universities in shaping access to higher education.

First, we document strong selection into online universities. Students enrolling in online programs are older, more likely to delay entry into higher education, to come from technical and vocational high-school tracks, and to reside in the South. They also display weaker academic preparation prior to enrollment, as measured by high-school grades and standardized test scores. By contrast, differences in socioeconomic background are more limited. Overall, online universities attract a distinctly non-traditional population, characterized by both academic and geographic constraints.

Second, we show that online bachelor's students exhibit better outcomes in terms of persistence and completion. Conditional on observable characteristics, they are less likely to drop out or switch programs and more likely to graduate on time. At the same time, they obtain slightly lower graduation grades. This combination of results suggests that online universities are associated with improved retention but not necessarily with higher measured academic achievement.

To better interpret these patterns, we analyze students who transition from online to traditional universities at the master's level. We find that students with an online bachelor's degree perform worse than their peers from traditional universities when evaluated in the same institutional environment. This evidence points to a gap in academic preparation that is not fully captured by observable characteristics.

Third, we provide suggestive evidence that online universities contribute to expanding access to higher education. Their growth is stronger in areas with lower initial enrollment rates, and they disproportionately attract students with a lower ex-ante probability of attending university. Taken together, these findings indicate that online universities operate, at least in part, along the extensive margin, bringing into higher education individuals who would otherwise be less likely to enroll.

Overall, the results highlight a trade-off. Online universities appear to widen access and improve completion rates, particularly for non-traditional students, but this expansion is accompanied by weaker academic performance when evaluated under traditional standards. From a policy perspective, these findings suggest that online universities can play an im-

portant role in increasing participation in higher education, especially in geographically or structurally disadvantaged contexts. At the same time, they raise questions about the quality and comparability of learning outcomes across different types of institutions.

These results point to the importance of policies aimed at strengthening academic preparation and support for students enrolled in online programs, as well as ensuring consistent evaluation standards across institutions. In this respect, recent regulatory changes that have tightened accreditation requirements for online universities—particularly with respect to minimum staffing and faculty standards—represent a step in this direction. Our findings suggest that fully online systems are, on average, less effective than in-person education, consistent with a large body of empirical literature indicating that blended learning models outperform fully distance-based approaches. These considerations should be taken into account in the design of more effective online higher education systems.

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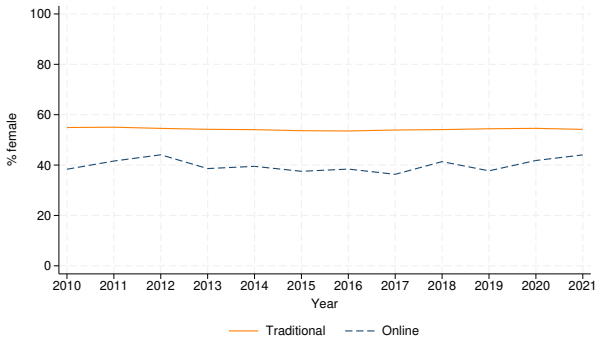
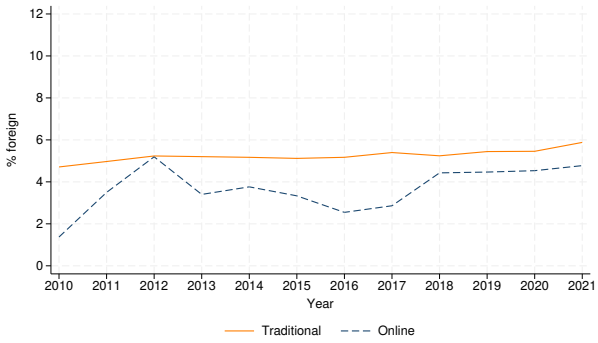
Additional Figures and Tables

Figure A1: **Students' characteristics over time: Demographics**

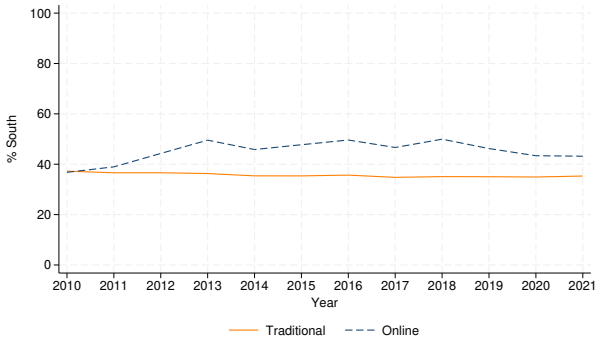
(a) Gender



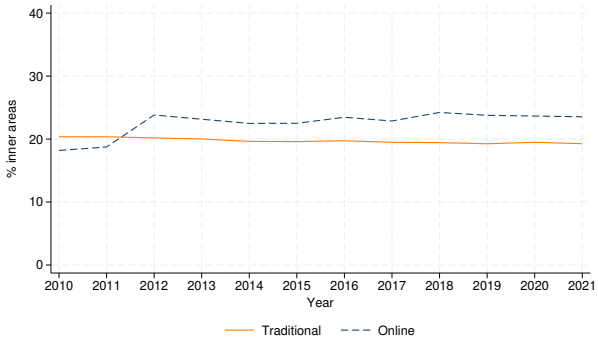
(b) Citizenship



(c) Area of residency



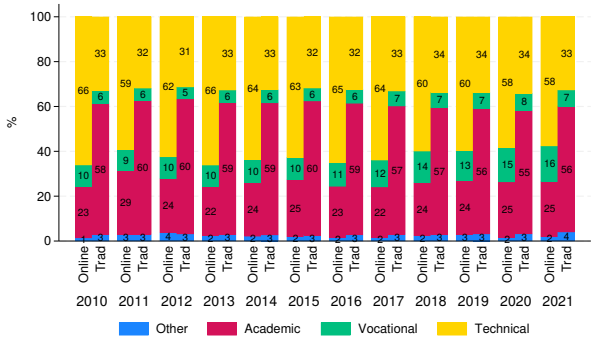
(d) Residency in inner areas



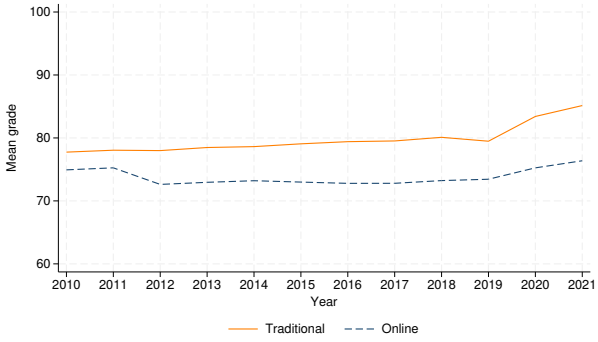
Notes: Data refer to the 2010-2021 enrollment cohorts of first-time bachelor's students. HS stands for "high school." Source: own elaborations on data from the Ministry of University and Research.

Figure A2: **Students' characteristics over time: HS and family background**

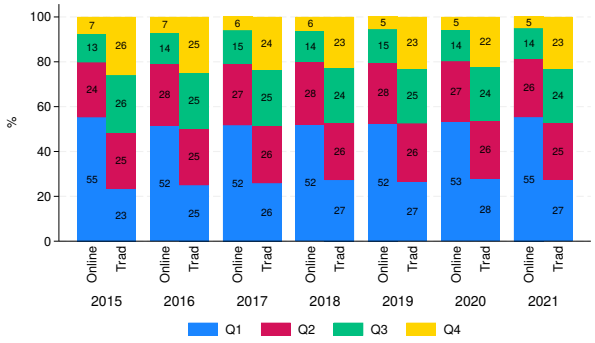
(a) Type of diploma



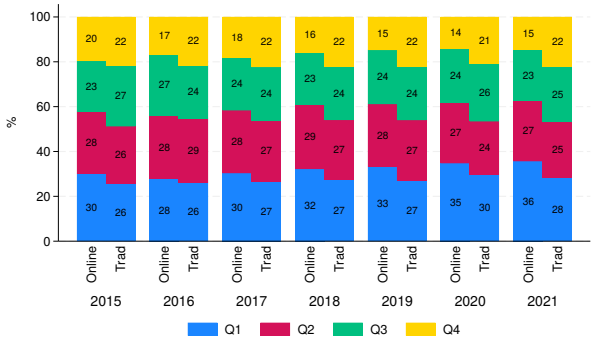
(b) HS grade of diploma



(c) INVALSI score



(d) SES



Notes: Data refer to the 2010-2021 enrollment cohorts of first-time bachelor's students. HS stands for "high school," SES stands for "socioeconomic status." Quartiles of INVALSI score and SES are measured in grade 10 and available only for the 2015-2021 enrollment cohorts. Source: own elaborations on data from the Ministry of University and Research, the Ministry of Education and Merit, and INVALSI.

Table A1: **Descriptive statistics by availability of INVALSI scores**

	No INVALSI	INVALSI	Difference
Panel A: Online universities			
Female (%)	37.90	46.40	-8.50***
Italian (%)	97.80	97.10	0.70***
South (%)	49.00	45.50	3.40***
Inner area (%)	23.60	25.10	-1.50***
Academic HS (%)	21.60	34.30	-12.60***
Technical HS (%)	64.90	51.50	13.50***
Vocational HS (%)	13.30	14.20	-0.90***
HS grade of diploma	73.22	76.71	-3.49***
Age at enrollment	31.29	20.18	11.11***
N. students	73,427	24,411	97,838
Panel B: Traditional universities			
Female (%)	54.20	54.60	-0.50***
Italian (%)	96.70	97.50	-0.80***
South (%)	39.70	32.10	7.60***
Inner area (%)	20.70	19.50	1.20***
Academic HS (%)	57.60	62.10	-4.60***
Technical HS (%)	34.60	32.30	2.30***
Vocational HS (%)	7.30	5.50	1.80***
HS grade of diploma	78.35	82.13	-3.78***
Age at enrollment	20.28	19.16	1.12***
N. students	1,509,462	1,005,013	2,514,475

Notes: The table reports descriptive statistics separately for students with and without available grade-10 INVALSI test scores. HS stands for "high school." Source: own elaborations on data from the Ministry of University and Research, the Ministry of Education and Merit, and INVALSI. *** denotes significance at 1%.

Table A2: **Descriptive statistics: online vs. traditional students**

	Online	**Traditional**	**Difference**
A. Demographics and HS background			
Female (%)	44.05	54.17	-10.12***
Italian (%)	95.23	94.12	1.11***
Age at enrollment	27.28	19.93	7.34***
South (%)	43.91	36.18	7.74***
Inner area (%)	23.94	19.73	4.20***
Academic HS (%)	24.58	56.17	-31.60***
Technical HS (%)	57.64	32.69	24.95***
Vocational HS (%)	15.75	7.14	8.61***
HS grade of diploma	76.38	85.14	-8.77***
Distance from HS diploma:			
0 years (%)	28.87	81.60	-52.73***
1 year (%)	8.87	6.48	2.38***
2 years (%)	5.97	1.90	4.07***
3 years (%)	5.20	1.01	4.19***
4 years (%)	4.64	0.70	3.94***
5 years (%)	4.05	0.49	3.56***
6 years (%)	3.16	0.33	2.83***
7+ years (%)	39.25	7.48	31.77***
B. INVALSI variables			
INVALSI score Q1 (%)	55.38	27.39	27.99***
INVALSI score Q2 (%)	26.06	25.48	0.58
INVALSI score Q3 (%)	13.62	24.27	-10.64***
INVALSI score Q4 (%)	4.94	22.86	-17.92***
SES Q1 (%)	35.70	28.36	7.33***
SES Q2 (%)	26.92	24.84	2.08***
SES Q3 (%)	22.86	24.62	-1.76***
SES Q4 (%)	14.52	22.18	-7.65***

Notes: Data refer to the 2021 enrollment cohort of first-time bachelor's students. The number of online (traditional) students ranges from 20,695 to 24,216 (227,839 to 239,343) in Panel A and from 9,970 to 10,613 (195,267 to 204,080) in Panel B. HS stands for "high school." Quartiles of INVALSI score and SES are measured in grade 10. Source: own elaborations on data from the Ministry of University and Research, the Ministry of Education and Merit, and INVALSI. *** denotes significance at 1%

Table A3: **Selection into online universities (Logit)**

	(1)	(2)	(3)
	Full sample	INVALSI	New HS graduates
Female	-0.012***	-0.005***	-0.002***
	(0.000)	(0.000)	(0.000)
Italian	0.009***	0.010***	0.003***
	(0.001)	(0.001)	(0.001)
South	0.019***	0.012***	0.006***
	(0.000)	(0.000)	(0.000)
Inner area	0.004***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)
Vocational HS	0.031***	0.014***	0.015***
	(0.000)	(0.001)	(0.001)
Technical HS	0.028***	0.012***	0.009***
	(0.000)	(0.000)	(0.000)
HS grade of diploma	-0.001***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)
Age at enrollment	0.004***	0.011***	0.002***
	(0.000)	(0.000)	(0.000)
INVALSI score Q2		-0.008***	-0.008***
		(0.000)	(0.000)
INVALSI score Q3		-0.014***	-0.012***
		(0.000)	(0.000)
INVALSI score Q4		-0.021***	-0.016***
		(0.000)	(0.000)
SES Q2		0.003***	0.002***
		(0.000)	(0.000)
SES Q3		0.004***	0.003***
		(0.000)	(0.000)
SES Q4		0.003***	0.002***
		(0.000)	(0.000)
Cohort FE	Yes	Yes	Yes
N. students	2612313	1029421	934081
$\bar{Y}$	0.037	0.024	0.015

Notes: The table reports the marginal effects of a logit model corresponding to the β coefficients from Equation (1). Column 1 considers the full sample of first-time bachelor's students enrolled between 2010 and 2021; column 2 considers the subsample of first-time bachelor's students enrolled between 2015 and 2021 who took the INVALSI test in grade 10 between 2012 and 2018; columns 3 further restricts the sample of column 2 by considering only students who enroll in the same year they graduate from high school. Standard errors are shown in parentheses. HS stands for "high school," SES stands for "socioeconomic status." $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%.

Table A4: **Academic performance (INVALSI subsample)**

	(1)	(2)	(3)	(4)
	Dropout	Switch	On-time	Grade
Online	-0.035***	-0.040***	0.107***	-1.133***
	(0.003)	(0.003)	(0.006)	(0.095)
Female	-0.026***	0.006***	0.043***	0.913***
	(0.001)	(0.001)	(0.001)	(0.025)
Italian	-0.002	-0.002	0.083***	1.444***
	(0.002)	(0.002)	(0.004)	(0.089)
South	0.024***	-0.014***	-0.135***	-0.545***
	(0.001)	(0.001)	(0.002)	(0.028)
Inner area	-0.003***	-0.003***	-0.021***	-0.223***
	(0.001)	(0.001)	(0.002)	(0.030)
Vocational HS	0.115***	-0.013***	-0.178***	-4.044***
	(0.002)	(0.001)	(0.003)	(0.065)
Technical HS	0.057***	-0.010***	-0.095***	-2.401***
	(0.001)	(0.001)	(0.002)	(0.027)
HS grade of diploma	-0.003***	-0.000***	0.012***	0.295***
	(0.000)	(0.000)	(0.000)	(0.001)
Age at enrollment	0.028***	-0.006***	-0.033***	0.017
	(0.001)	(0.000)	(0.001)	(0.024)
INVALSI score Q2	-0.012***	0.001	0.029***	0.378***
	(0.001)	(0.001)	(0.002)	(0.034)
INVALSI score Q3	-0.022***	0.002**	0.057***	1.009***
	(0.001)	(0.001)	(0.002)	(0.035)
INVALSI score Q4	-0.028***	-0.008***	0.097***	1.624***
	(0.001)	(0.001)	(0.002)	(0.038)
SES Q2	-0.005***	0.003***	0.012***	0.015
	(0.001)	(0.001)	(0.002)	(0.032)
SES Q3	-0.007***	0.004***	0.016***	0.099***
	(0.001)	(0.001)	(0.002)	(0.033)
SES Q4	-0.013***	0.005***	0.030***	0.213***
	(0.001)	(0.001)	(0.002)	(0.034)
Cohort FE	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes
N. students	667604	667608	505373	322765
$\bar{Y}$	0.086	0.060	0.440	101.467

Notes: The table reports the estimated β and γ coefficients from Equation (2), focusing on the subsample of students who took the INVALSI test in grade 10. To have a sufficient time horizon to measure each performance outcome, columns 1 and 2 consider first-time bachelor's students enrolled between 2015 and 2019, while columns 3 and 4 consider those enrolled between 2015 and 2018. Standard errors are shown in parentheses. HS stands for "high school," SES stands for "socioeconomic status." The omitted category for the type of HS diploma is academic HS, while that for the INVALSI score and SES is the first quartile. $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%, ** denotes significance at 5%.

Table A5: **Academic performance (New HS graduates subsample)**

	(1) Dropout	(2) Switch	(3) On-time	(4) Grade
Online	-0.022***	-0.044***	0.068***	-1.244***
	(0.004)	(0.003)	(0.008)	(0.109)
Female	-0.024***	0.007***	0.042***	0.902***
	(0.001)	(0.001)	(0.001)	(0.025)
Italian	-0.000	0.000	0.077***	1.228***
	(0.002)	(0.002)	(0.004)	(0.093)
South	0.023***	-0.013***	-0.141***	-0.701***
	(0.001)	(0.001)	(0.002)	(0.030)
Inner area	-0.002**	-0.003***	-0.022***	-0.227***
	(0.001)	(0.001)	(0.002)	(0.031)
Vocational HS	0.121***	-0.014***	-0.185***	-4.153***
	(0.002)	(0.002)	(0.003)	(0.070)
Technical HS	0.058***	-0.010***	-0.099***	-2.446***
	(0.001)	(0.001)	(0.002)	(0.028)
HS grade of diploma	-0.003***	-0.000***	0.012***	0.299***
	(0.000)	(0.000)	(0.000)	(0.001)
Age at enrollment	0.024***	-0.003***	-0.041***	-0.443***
	(0.001)	(0.001)	(0.001)	(0.030)
INVALSI score Q2	-0.011***	0.001	0.031***	0.386***
	(0.001)	(0.001)	(0.002)	(0.036)
INVALSI score Q3	-0.021***	0.002**	0.059***	1.021***
	(0.001)	(0.001)	(0.002)	(0.036)
INVALSI score Q4	-0.027***	-0.008***	0.097***	1.611***
	(0.001)	(0.001)	(0.002)	(0.039)
SES Q2	-0.005***	0.003***	0.013***	0.018
	(0.001)	(0.001)	(0.002)	(0.033)
SES Q3	-0.007***	0.004***	0.016***	0.097***
	(0.001)	(0.001)	(0.002)	(0.034)
SES Q4	-0.013***	0.005***	0.030***	0.209***
	(0.001)	(0.001)	(0.002)	(0.035)
Cohort FE	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes
N. students	613760	613764	467922	305357
$\bar{Y}$	0.078	0.062	0.447	101.464

Notes: The table reports the estimated β and γ coefficients from Equation (2), focusing on the subsample of students who took the INVALSI test in grade 10 and who enrolled in the same year they graduated from high school. To have a sufficient time horizon to measure each performance outcome, columns 1 and 2 consider first-time bachelor's students enrolled between 2015 and 2019, while columns 3 and 4 consider those enrolled between 2015 and 2018. Standard errors are shown in parentheses. HS stands for "high school," SES stands for "socioeconomic status." The omitted category for the type of HS diploma is academic HS, while that for the INVALSI score and SES is the first quartile. $\bar{Y}$ denotes the mean of the outcome variable in the estimating sample. *** denotes significance at 1%, ** denotes significance at 5%.

Table A6: **Descriptive statistics: Switchers vs. stayers**

	(1) O-T	(2) O-O	(3) T-O	(4) T-T
Female (%)	55.2	48.1	56.1	56.0
	(50.0)	(50.0)	(49.6)	(49.6)
Italian (%)	99.0	98.9	99.2	97.6
	(10.2)	(10.4)	(9.0)	(15.3)
South (%)	57.7	62.6	57.9	36.4
	(49.4)	(48.4)	(49.4)	(48.1)
Inner area (%)	26.2	25.4	25.2	20.0
	(44.0)	(43.6)	(43.4)	(40.0)
Academic HS (%)	51.4	33.9	55.4	73.0
	(50.0)	(47.3)	(49.7)	(44.4)
Vocational HS (%)	6.3	7.1	5.5	2.4
	(24.3)	(25.7)	(22.9)	(15.2)
Technical HS (%)	41.4	58.3	38.5	23.3
	(49.3)	(49.3)	(48.7)	(42.3)
HS grade of diploma	76.1	74.6	77.1	82.7
	(10.8)	(11.0)	(11.0)	(11.6)
Age at enrollment	21.9	27.2	19.9	19.2
	(7.2)	(11.1)	(3.7)	(1.8)
Bachelor's graduation grade	97.7	97.2	96.7	100.9
	(8.1)	(7.8)	(8.3)	(7.9)
Years from bachelor to master	1.4	1.4	2.1	1.3
	(0.7)	(0.8)	(1.2)	(0.5)
N. students	768	3909	3331	428375

Notes: Data refer to students who started a master's program between 2013 and 2018 (i.e., first-time bachelor's students enrolled between 2010 and 2015). Standard deviations are shown in parentheses. Column 1 refers to students switching from online to traditional universities after the bachelor's degree, column 2 to students staying in online universities, column 3 to students switching from traditional to online universities, and column 4 to students staying in traditional universities. HS stands for "high school." Source: own elaborations on data from the Ministry of University and Research and the Ministry of Education and Merit.