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By choice or by necessity? Spatial disparities of student mobility in the Italian higher education system

Nicolò Avogadro [a], Alice Civera [a], Antonio Di Donato[b], Michele Meoli [a] and Stefano Paleari[a]

[a]Department of Management, Information and Production Engineering, University of Bergamo, Dalmine, Italy; [b]Unità di Missione per l'attuazione degli interventi del PNRR, Ministero dell'Università e della Ricerca, Rome, Italy

ABSTRACT

This paper presents a spatial interaction model of aggregate student flows to 78 public and private Italian universities in the 2011–22 period, providing evidence of distinct determinants for two categories of mobility: mobility by choice and mobility by necessity. Mobility by necessity is strongly associated with the cost of education and economic prosperity in the destination area, while mobility by choice is tied to the perceived quality of education and overall living conditions in the destination area. Policymakers currently handle these two types uniformly, but tailored policies could be considered in light of the amount of public funds devoted to student support. Income-based financial aid is especially relevant in the case of mobility by necessity, which is closely linked to economic constraints and territorial disparities. In contrast, merit-based instruments and greater institutional or regional autonomy in managing admissions could be explored as potential policy options for mobility by choice.

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1. Introduction

The geographical mobility of university students has increasingly attracted the interest of both academics and policymakers over the last decades (Ballarino et al., 2022; Carrascal Incera et al., 2022). Understanding how and why students move across space is crucial because these flows shape the spatial distribution of human capital and influence regional development trajectories (Etzo et al., 2025). Student mobility affects the competitiveness and attractiveness of cities, provinces and regions (Carrascal Incera et al., 2022; Imeraj et al., 2018). It fuels local housing markets through an increased demand for accommodation (Sa et al., 2004; Türk, 2019) and stimulates local economies because a significant portion of graduates remain to work in the place where they studied (Dotti et al., 2013; Tosi et al., 2019). Therefore, student mobility represents a stage in the people's life course as well as a key mechanism for regional transformation and spatial inequality reproduction (Etzo et al., 2025).

The Italian context is interesting in this regard. First, it is characterised by a wide geographical divide between the north and south, greater than in other countries (Ballarino et al., 2022; Nifo & Vecchione, 2014). Second, Italy's tertiary education attainment remains below the European average; according to the statistics provided by Eurostat, only 30.6% of Italy's population aged 25–34 years held a tertiary degree in 2023, while the European Union average was 43%. Third, the principle that all universities are equal prevails in Italy due to the *legal value* of university degrees, which prevents any vertical differentiation (Rossi, 2010). Fourth, the government has pursued policies for expanding the number of universities throughout Italy, particularly in the peripheral regions, to increase accessibility (Ballarino, 2015; Rossi, 2010).

Despite this political effort, university student mobility in Italy has risen over the last decade (Cattaneo et al., 2017b; Tosi et al., 2019). According to the Italian Ministry of University and Research's (MUR) data, nearly 800,000 students – more than half of the total university population – studied outside their home provinces in 2022, an increase of almost 8% since 2017. Mobility patterns mirror and reinforce territorial disparities: Universities in the north have expanded their enrolments (+8%), while those in the centre, south

CONTACT Alice Civera alice.civera@unibg.it
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and islands have experienced significant declines (−10%, −24% and −28%, respectively). Student inflows are concentrated in regions with high-quality universities, well-developed infrastructures and better employment opportunities (Dotti et al., 2013; Nifo & Vecchione, 2014), exacerbating the south–north divide and socio-economic inequalities (Ballarino et al., 2022; Tosi et al., 2019; Türk, 2019). In this study, we integrate higher education geography with regional development to extend the regional studies discussion on how human capital mobility reflects and reproduces uneven development patterns (Ehrenfried et al., 2023; Etzo et al., 2025).

Spatial approaches, particularly spatial interaction and gravity models, provide robust theoretical and empirical frameworks that emphasise the embeddedness of student mobility in a spatial system characterised by geographical dependence (Sa et al., 2004; Türk, 2019). These models capture how origin and destination characteristics shape mobility decisions (Cullinan & Duggan, 2016; Dotti et al., 2013). Researchers have examined the role of distance between origin and destination (Ehrenfried et al., 2023; Etzo et al., 2025; Sa et al., 2004) and that of mobility determinants at the individual (Ballarino et al., 2022; Marinelli, 2013; Tosi et al., 2019), regional (Carrascal Incera et al., 2022; Imeraj et al., 2018; Nifo & Vecchione, 2014) and institutional (Bratti & Verzillo, 2019; Cattaneo et al., 2017a; Ciriaci, 2014) levels.

However, student mobility is generally treated as a homogeneous phenomenon, which obscures any underlying heterogeneity. Seminal US studies by Tuckman (1970) and Mixon (1992a, 1992b) have introduced an important conceptual distinction between voluntary mobility (relocation despite access to local universities) and non-voluntary mobility (arising from the absence of local options). Building on this distinction, our study advances the theoretical and empirical understanding of student mobility within a spatial framework. Conceptually, we reinterpret voluntary and non-voluntary mobility as *mobility by choice* and *mobility by necessity*, respectively, and integrate them into a model of spatial interdependence. The relevance of distinguishing mobility types in relation to spatial distribution has been largely overlooked. Marinelli (2013), who examined return-migrants (graduates who relocate to study and later return home) and onward-migrants (graduates who move to a different region), is a notable exception. These groups differ in geographical patterns, with onward-migrants primarily moving to the centre–north regions and returnees mostly remain in the south, as well as in individual traits, academic performance and labour-market behaviour.

Methodologically, we extend traditional gravity models by incorporating spatial dependence across regions and estimating separate determinants for each mobility type. Our empirical strategy involves estimating a gravity model in which province-level student mobility flows uniquely identified by province of origin and the destination university's local units and fields of study are regressed on the origin and destination provinces' socio-economic characteristics and the destination university's features.

Empirically, we refine the MUR's definition of mobile students (also referred to as *fuori sede* in the Italian context) as students enrolled in a university in a province (or region) different from the one in which they live. This national definition of mobile students is based solely on administrative boundaries and may therefore provide a distorted representation of actual mobility patterns. Students are formally classified as mobile for crossing a regional border even when living close to it, while those travelling long distances within a region are not considered mobile. For example, the University of Verona offers study programmes at its Verona campus (Veneto). Students who come from Belluno (also in Veneto) are not classified as mobile, although the travel time to Verona is about 130 min by car. Conversely, students coming from Brescia (Lombardy) are considered mobile, despite their travel time being only about 50 min.

To overcome these limitations, we assess student mobility based on travel time by car between students' residences and universities' local units. Students are classified as mobile if their travel time exceeds 90 min – the maximum threshold of daily travel time that students are willing to undertake to reach their university (Corcoran et al., 2018). Beyond this limit, students tend to relocate, thus becoming, in practical terms, mobile students.[1] The 90-min threshold is consistent with specific regional practices in Italy, as several regions, including Lombardy and Emilia-Romagna, use this criterion to define mobile students for policy and funding purposes. From a practical perspective, commuting for over 90 min each way would significantly reduce the time available for study, rest and social activities, making relocation more viable. Based on this threshold, we further distinguish student mobility by choice and necessity. Mobility by necessity refers to flows of students residing in areas where a given field of study is not offered by any university accessible within a 90-min travel time, whereas mobility by choice refers to mobility flows that occur despite the

presence of at least one university offering the same field of study and accessible within the 90-min travel time threshold.

We analyse the aggregate flows of mobile students enrolled in 78 public and private universities in Italy over the 2011–22 period for each mobility type. The findings demonstrate that the determinants of student mobility by necessity differ from those of mobility by choice. The former is more dependent on the distance and destination university's tuition fees, while the latter is substantially directed towards universities with higher tuition fees and greater teaching resources, in line with a 'flight to quality' pattern (McCaig, 2016). The socio-economic characteristics of the destination are relevant for both mobility types, as flows are mainly directed towards economically advanced destinations: the presence of better economic opportunities drives mobility by necessity, while quality of life also drives mobility by choice. Beyond documenting spatial mobility patterns, this study contributes to understanding Italy's persistently low tertiary education attainment. The analysis shows how access to higher education is shaped by territorial constraints and necessity-driven mobility, thus highlighting structural barriers that may limit participation in higher education, particularly in peripheral and economically disadvantaged areas.

This study provides valuable insights for policymakers. Currently, the two mobility flows are treated uniformly and supported by the same student financial aid system – the Right to University Studies (explained below in Section 3). However, considering the differences in key determinants and the heterogeneous flows, it would be appropriate to design and implement tailored policies. Mobility by necessity could be a central regulatory objective aimed at supporting marginalised areas and students, while mobility by choice could be the responsibility of single regions or universities.

The rest of this paper is structured as follows. Section 2 introduces the theoretical framework. Section 3 describes the research design, including the Italian institutional setting, the data-collection process, our novel definition of mobile students, and an explanation of the empirical model and variables used. Section 4 presents the empirical results, specifically the descriptive evidence, main analysis, spatial dynamics and robustness checks. Section 5 includes a summary of the main findings, the conclusions, and the study's contributions and limitations.

2. Theoretical framework

Student mobility is commonly conceptualised as a form of high-skilled migration and is analysed via spatial modelling (Ciriaci, 2014; Nifo & Vecchione, 2014; Tosi et al., 2019). This literature shows that mobility choices emerge within a spatial system where both origin and destination characteristics matter (Ballarino et al., 2022). Student mobility has an inherently spatial nature, with territorial contexts shaping educational opportunities and outcomes (Cullinan & Duggan, 2016). Within this framework, several spatial mechanisms explain how geography affects higher education choices. The first is *spatial accessibility*: the ease of reaching universities. Greater distances increase financial, informational and psychological costs, reducing the likelihood of enrolling in distant institutions (Gibbons & Vignoles, 2012; Sa et al., 2004; Spiess & Wrohlich, 2010; Suhonen, 2014). Second, *spatial competition* emerges when neighbouring universities compete for the same pool of students; central institutions face strong competition, while peripheral universities rely heavily on local catchment areas (Cattaneo et al., 2017a; Sa et al., 2004). Third, *spatial spillovers* arise as information, opportunities and reputation diffuse across territories, indirectly increasing the attractiveness of nearby regions with high-quality universities or dynamic labour markets (Dotti et al., 2013; Nifo & Vecchione, 2014). These interdependencies indicate that mobility belongs to a broad spatial system of flows rather than a set of isolated decisions.

Spatial interaction and gravity modelling traditions (Fotheringham & O'Kelly, 1989; Sa et al., 2004) provide theoretical frameworks for analysing mobility as a function of regional attractiveness and distance. These models provide realistic representations of the choices embedded in interconnected regional systems, as the scale of student flows is considered dependent on spatially distributed opportunities. These models have been applied in empirical studies to analyse how distance, accessibility and centrality shape student mobility (Türk, 2019) through interactions with a broad range of mobility determinants (see Sa et al., 2004, for a review). The determinants can be grouped into three categories: (1) individual characteristics, such as gender (Faggian et al., 2007; Gibbons & Vignoles, 2012), prior school performance (Ballarino et al., 2022; Marinelli, 2013) and family background (Ballarino et al., 2022; Tosi et al., 2019; Türk, 2019);

(2) destination-level regional features, including socio-economic conditions (Imeraj et al., 2018), housing costs (Sa et al., 2004), cultural and social services (Nifo & Vecchione, 2014; Sa et al., 2004), and labour market opportunities (Bratti & Verzillo, 2019; Dotti et al., 2013, 2014), which often outweigh those of the origin area; and (3) institutional factors, such as university reputation (Bratti & Verzillo, 2019; Ciriaci, 2014), programme offerings (Sa et al., 2004) and tuition fees or student aid (Hübner, 2012; Murphy et al., 2019).

Investigations of all these determinants have highlighted spatial disparities between north and south Italy. Mobile students tend to be male, from middle- or upper-class families, and with strong prior academic performance (Ballarino et al., 2022). Female students are generally less mobile and more likely to remain near their parental homes (Gibbons & Vignoles, 2012), partly due to differing mobility propensities, preferences and constraints (Cattaneo et al., 2017a). Students' prior abilities strongly predict mobility: Tosi et al. (2019) show that upper-secondary school performance increases relocation likelihood, even after controlling for family background. Given that academic achievement is itself socially stratified, this finding is consistent with evidence that advantaged families are better able to support their children's mobility (Türk, 2019). Regional disparities also affect mobility. Ballarino (2015) found that long-distance flows (over 500 km) are predominantly from the south to the north. Dotti et al. (2013) have interpreted this in terms of labour market attractiveness: Dynamic, innovative regions draw high-performing individuals from underdeveloped areas (Marinelli, 2013), due to differences in wages and unemployment rates (Dotti et al., 2014). The institutional dimension has been extensively studied through university-specific factors (Cattaneo et al., 2017b; Dotti et al., 2013, 2014; Marinelli, 2013). Local institutional quality reinforces the aforementioned patterns via improved services, infrastructure and administrative efficiency (Nifo & Vecchione, 2014). In particular, research and teaching performance strongly influence mobility. Ciriaci (2014) found that students living in regions with high-quality universities and graduates from high-quality institutions are less likely to relocate. Bratti and Verzillo (2019) have reported that research quality attracts inflows, but they emphasised that relocation costs often outweigh quality considerations. Spatial distribution also matters: a high concentration of universities increases provincial attractiveness, though competition among institutions may reduce individual inflows (Cattaneo et al., 2017b).

Despite the breadth of this literature, mobile students are usually treated as a homogeneous group. However, Tuckman (1970) and Mixon (1992a, 1992b) distinguish between two main forms of mobility: *non-voluntary mobility* occurs when local colleges are insufficient, leaving students with no choice but to move; *voluntary mobility* occurs when students leave to obtain the education they prefer in terms of college type, prestige and selectivity. Tuckman (1970) found that high in-state tuition and per capita income levels increase migration, although income does not significantly affect voluntary moves. Mixon (1992a, 1992b) included climate, quality and selectivity in their model and found that high tuition levels and colleges of relatively low quality or high selectiveness tend to increase voluntary out-migration. Building on this in the next section, we introduce a modified gravity model that distinguishes between voluntary and non-voluntary mobility and revisit it as mobility by choice and by necessity.

3. Research design

3.1. Institutional setting

To study the determinants of student mobility, we must consider the enrolment criteria and key measures that promote equal access to tertiary education – in broad terms, *accessibility*. To enter the Italian university system, prospective students must fulfil the minimum secondary education standards set by the national government. All high school graduates typically have access to post-secondary education. There is no rationalisation of university access, with the exception of a few study programmes such as medicine, dentistry, veterinary science, education and architecture, for which a student cap is set based on the potential labour market demand (*numerus clausus*). Admission to these programmes involves an entrance exam and a nationwide ranking list, similar to other European countries (Declercq & Verboven, 2018; Sa et al., 2004).

Two interconnected mechanisms are in force in the Italian university system to promote equal access to university education: (1) an increasing number of universities and (2) the design of student support policies through the 'Right to University Studies' programme (*Diritto allo studio*, henceforth DSU). The first mechanism reduces the geographical distance between university facilities and the population and decreases the

likelihood of students relocating for education; this especially benefits remote areas in Italy (Cattaneo et al., 2017b; Dotti et al., 2014). The second mechanism reduces the financial burden on families and facilitates the increased participation of students with disadvantaged socio-economic backgrounds (Dynarski, 2002; Vergolini & Zanini, 2015).

The first mechanism mirrors the trends seen in other Western nations. In Italy, public universities significantly expanded from 1945 to 1980 to meet the increasing demand (Rossi, 2010). Afterwards, private universities grew rapidly and comprised half of the 35 institutions founded post-1990, compared with just one in 10 between 1960 and 1990. Privatisation accelerated after 2000, driven by the rise of private distance-learning institutions, 11 of which were established between 2000 and 2006. This expansion addressed higher education massification by increasing accessibility and competition. According to the MUR, Italy currently has 100 universities: 69 public and 31 private. Among the public institutions, eight are doctoral schools, and have special legal status, and three are universities for foreigners.[2] The private universities comprise 17 traditional private institutions, three semi-public institutions (*università parastatali*) and 11 distance-learning institutions offering exclusively online education. Unlike traditional public universities, semi-public universities are not affiliated with the state but are publicly funded and managed by public territorial authorities. In this sense, they differ from traditional private institutions, which are privately owned and managed. Semi-public institutions comprise the universities of Aosta, Bolzano and Enna Kore. Most Italian students attend public universities. In 2022, out of 1.9 million students, 83% were enrolled in public institutions, 10% in private traditional universities and 7% in private distance-learning institutions. Admission generally requires a secondary school diploma, and most programmes are open access except for *numerus clausus* degrees.[3] Public and private universities differ in funding and tuition. Public universities are mostly funded through the *Fondo di Finanziamento Ordinario* (FFO), which amounted to about €9.2 billion in 2023, whereas private universities receive less than 1% of the FFO and depend largely on tuition fees. By law, student contributions to public universities cannot exceed 20% of the FFO, keeping annual tuition around €900–1000. Private institutions charge substantially higher fees, averaging €3400 and reaching €20,000.

The second mechanism, namely the DSU, is the main national student aid scheme established to support the enrolment and retention of low-income students (Prime Ministerial Decree, 9 April 2001) and is managed regionally with MUR coordination (Legislative Decree 68/2012). The DSU agencies offer two types of support: grants and accommodation services. Grants consist of direct monetary transfers, while accommodation includes DSU dormitory placements or rental support for students living away from home. Scholarships are co-funded by the MUR, regional governments and mandatory student fees. Each region administers its own DSU agency, applying national rules on minimum grant amounts, income thresholds and eligibility criteria, but adjusting the specific rules and supplementing the funding through regional resources. Eligibility is based on economic need and academic merit. The economic criterion requires that students' family incomes must not exceed the national threshold of approximately €23,000, while the merit requirements include a qualifying high-school grade for first-year students and a minimum number of earned credits for second- and third-year students. Students apply at the DSU office of their university and are ranked by income, merit and distance. Depending on residence, students are classified as on-site (*in sede*), commuting (*pendolari*) or mobile (*fuori sede*). On-site students receive the smallest grant; commuters receive intermediate support; and mobile students – who relocate for study – receive the full grant and may access DSU housing. Students renting privately receive a slightly higher allowance.

Alongside DSU scholarships, universities may award their own institutional scholarships, which are typically merit-based and less tied to financial need. These grants are funded through university budgets, including MUR allocations and institutional resources. They typically support high-achieving students, study-abroad programmes (e.g., Erasmus) and students with disabilities. Universities establish their own criteria and amounts, resulting in flexible but less redistributive aid compared with DSU schemes.

From a financial point of view (Figure 1), public funding devoted to supporting DSU through student grants and dorms is consistent and has increased 2.7-fold during the last decade, from €366 million in 2011 to €1019 million in 2022. The funding sources are national and regional, and since 2020, public funding has gained additional resources from the National Recovery and Resilience Plan.

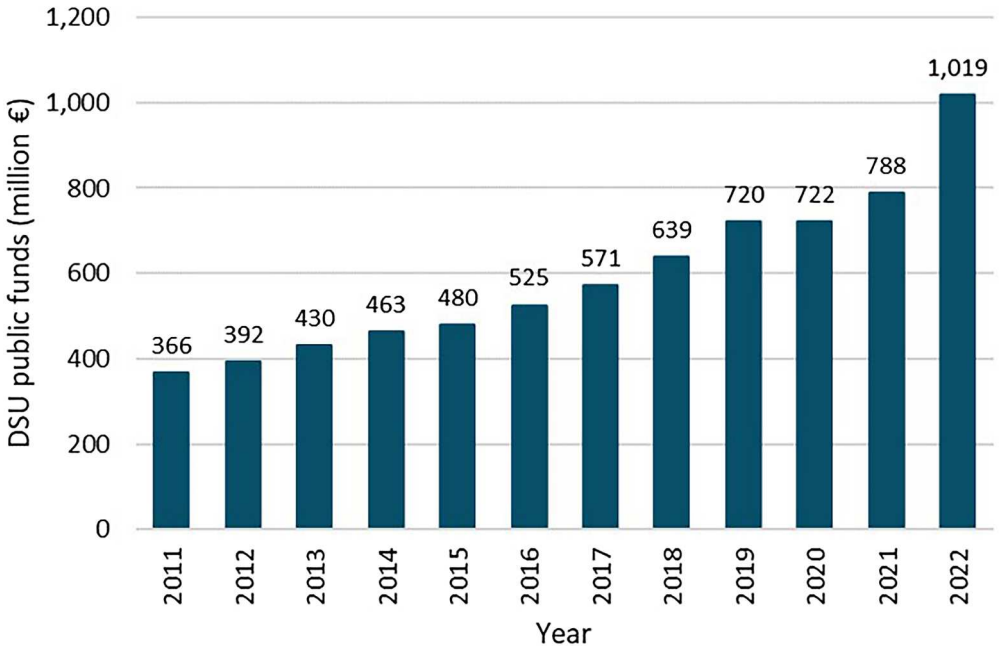

Figure 1. Public funding for financing *Diritto allo studio* (DSU), 2011–22.

3.2. Data

Our analysis covers the 2011–22 period. It builds on data from USTAT, an open portal provided by the MUR as the primary source of information on Italian universities over time. We focus on traditional public and private universities, excluding all 11 distance-learning institutions, eight doctoral universities and three universities for foreigners because they serve specific niches in higher education (Cattaneo et al., 2017b). Accordingly, the analysis covers 78 traditional universities. Given the analysis scope (i.e., student mobility on a national scale), incoming international students and Italian students studying abroad are excluded.

Based on the data granularity at our disposal, the level of analysis is based on combinations of an institution (i.e., university), a field of study and the local unit (i.e., province where the specific university offers the given field). This includes 1179 uniquely identified aggregates. The fields of study are derived from the MUR, which groups study programmes into 15 general fields based on international standards (ISCED-F 2013).[4] The Polytechnic University of Milan in the local unit of Lecco and the industrial engineering and manufacturing field is an example of this combination. For each aggregate, USTAT provides the number of enrolled students by academic year and province of origin (i.e., province of student residence). Although degree-level data are also available, they are not disaggregated by student residence – an essential input for our spatial analysis. Consequently, our analysis relies on the field-of-study level.

Table 1 presents the distribution of the 1.56 million enrolled Italian students in 2022 by geographical macro-area. If we consider residence (the left side of Table 1), the geographical distribution of students should reflect the distribution of the total reference population aged 19–25 years. However, some differences emerge as fewer young people were enrolled in universities in the north (around 33%) than in the centre (42.8%), south (41.9%) and islands (38.5%). Since 2011, the student population has significantly declined (−8.9% at the national level), with the south and the islands seeing a sharp decrease of 19% jointly and the north remaining stable.[5]

A different pattern emerges when examining student enrolment by macro-area (the right side of Table 1). Northern regions have attracted more students than their resident student population; the percentages of students in the north-west (25.9%) and north-east (19.9%) surpassed those of local residents (23.2% and 16.9%, respectively). The same trend is observed in the centre. In contrast, southern regions experienced a significant outflow of students: only 21.3% of the 27.3% of students living in the south were enrolled

Table 1. Distribution of Italian students by geographical macro-area, 2022.

	Residence within the macro-area[a]					Studying in the macro-area[b]		
Macro-area	Students (*n*; %)		$\Delta\%_{vs.2011}$[c]	Pop.19–25[d]	Tertiary education rate[e]	Students (*n*; %)		$\Delta\%_{vs.2011}$[c]
North-west	362,529	23.2%	+3.4%	26.3%	33.26%	405,343	25.9%	+10.1%
North-east	263,886	16.9%	+0.3%	19.3%	32.94%	310,611	19.9%	+4.2%
Centre	332,795	21.3%	−6.3%	18.8%	42.78%	372,640	23.8%	−10.4%
South	427,161	27.3%	−19.2%	24.6%	41.90%	332,458	21.3%	−23.8%
Islands	176,343	11.3%	−19.1%	11.0%	38.49%	141,662	9.1%	−28.1%
Total	1,562,714	100%	−8.9%	100%	37.69%	1,562,714	100%	−8.9%

Note: [a]Analysis from the perspective of student residence, investigating the number of students and relative distribution with respect to the population of university-age individuals within each geographical macro-area.
[b]Analysis of universities located within each macro-area, investigating the number of students enrolled in institutions within each geographical macro-area.
[c]Percentage change relative to the value observed in 2011.
[d]Distribution of the population aged 19–25 years. Source: ISTAT.
[e]Enrolment rate in tertiary education, defined as the ratio between the number of students and the population aged 19–25 years.

locally, a trend also evident in the islands. This trend is more pronounced when comparing 2022 with 2011: universities in the north saw increased student numbers despite the decline at the national level (+10.1% for north-west and +4.2% for north-east); the south and the islands saw a substantial decline (−23.8% and −28.1%, respectively); and the centre experienced a smaller decline (−10.4%).

3.3. Mobile student definition

As noted in Section 3.1, the support offered by the DSU changes according to students' location status, with greater amounts of funding provided to mobile students. Therefore, the definition of mobile student is pivotal in determining the coverage of DSU measures and the extent of resources needed.

Currently, mobile students are defined by the MUR as 'students enrolled in a course of study whose teaching location is in a province/region other than that of the school in which they obtained their secondary school diploma' (MUR Methodological note). As Italian students typically enrol in secondary schools in their residential province, this definition is ultimately based on students' place of residence. Individual regions use autonomously customised criteria to refine this broad definition, resulting in a fragmented framework across the country. For instance, Lombardy defines mobile students as those studying at least 90 min away from their residence by public transport, while Veneto considers a road distance beyond 80 km. Trento's autonomous province defines mobile students as those living in a different province.

In this study, we propose a novel, more sophisticated approach to defining mobile students based on actual distance in terms of travel time rather than on mere administrative boundaries, partially in line with current practices in some regions. To this end, we collected data on the travel distance and time for each university (institution and local unit) and student province of residence combination from Openrouteservice, with travel time based on private car use. According to spatial theory, travel distance and time have a possible mobility deterrent effect because of transportation costs, accommodation requirements and distance from home (Gibbons & Vignoles, 2012; Sa et al., 2004). We then identified students who could be classified as mobile students based on a travel time threshold of 90 min, which distinguishes them from local students and commuters. Accordingly, we define mobile students as those in a specific field of study at a certain university in a given province (i.e., local unit) who are at least 90 min away from the capital town of their province of residence.[6]

Table 2 presents the number of mobile students according to our definition (90-min criteria) compared with the number of mobile students according to the ministerial definition (region or province-based criteria). The number of mobile students is strongly overestimated by the province-based criteria: Half of the total students enrolled in 2022 studied in a province different from their residence, while only 21.3% of them travelled for over than 90 min from their residential province to study. This has relevant policy implications, as the inflated number of mobile students considered by the MUR leads to an overestimation of the scholarship demand and an escalation of related costs. The region-based criteria provide a similar number of mobile students to that estimated using the 90-min threshold. However, 21.7% of students studying in another region are likely to differ from 21.3% of those studying more than 90 min from home because of the connectivity between geographical areas. In Italy, connectivity between provinces (and between

Table 2. Mobile students according to different criteria.

		Mobile students					
		90-min criteria		Region-based criteria		Province-based criteria	
Year	Students	*n*	%	*n*	%	*n*	%
2011	1,715,172	301,248	17.6%	293,105	17.1%	782,502	45.6%
2012	1,669,460	299,752	18.0%	293,187	17.6%	771,079	46.2%
2013	1,611,708	294,402	18.3%	289,013	17.9%	752,634	46.7%
2014	1,568,824	291,973	18.6%	287,675	18.3%	741,558	47.3%
2015	1,542,002	293,452	19.0%	289,937	18.8%	737,469	47.8%
2016	1,518,059	292,791	19.3%	292,072	19.2%	733,771	48.3%
2017	1,518,283	298,498	19.7%	299,145	19.7%	741,006	48.8%
2018	1,524,858	304,029	19.9%	306,162	20.1%	750,202	49.2%
2019	1,526,369	307,855	20.2%	311,670	20.4%	757,397	49.6%
2020	1,538,589	311,240	20.2%	315,554	20.5%	766,912	49.8%
2021	1,565,085	324,509	20.7%	328,707	21.0%	790,078	50.5%
2022	1,562,714	333,587	21.3%	338,339	21.7%	799,676	51.2%

regions) varies considerably, and mobility across provinces (and regions) may be much easier than mobility within the same province.

3.4. Empirical model

In addition to defining student mobility based on travel time, we classify mobility flows into two categories: mobility by choice and by necessity. Mobility by necessity arises when students' preferred fields of study are not offered by any university within a 90-min travel time by car from their residential area. Mobility by choice occurs when at least one university offering the required field of study is available within a 90-min travel time but enrolment nevertheless occurs at a university located beyond this threshold.

In making this distinction, we implicitly assume the perfect substitutability of programmes within each field. For example, we consider architecture and construction engineering equivalent because they belong to the same disciplinary area. Although we acknowledge potential heterogeneity across degrees within individual fields, this assumption cannot be relaxed given the level of aggregation in the available USTAT data. We recognise this as a key limitation of our study, which future researchers could address if detailed data become available.

The viable alternatives used to determine the student mobility type encompass private and public universities. A potential concern is that private universities may be less accessible due to higher tuition fees or selectivity, which could bias the classification of mobility by choice. Therefore, we verified that excluding 17 traditional private universities does not alter the classification outcomes, as these are concentrated in large cities, such as Rome and Milan, where public alternatives are widely available.[7] Maintaining this combined pool allows us to capture the full range of realistic options available while avoiding an over-restrictive definition of alternatives.

Our hypothesis is that student mobility by necessity and by choice differ because they are influenced by distinct determinants; therefore, they require tailored policy measures for support. To investigate mobility drivers, we herein provide a spatial interaction model involving a gravity equation of student flows based on previous studies on the topic (e.g., Türk, 2019). Student flows are modelled (equation 1) as a function of origin and destination area features, specifically socio-economic conditions, destination university and local unit characteristics, and the distance between the origin province and the destination local unit (Cattaneo et al., 2017b; Dotti et al., 2013). The model specifications are as follows:

$$F_{i,j,t,k} = O(Prov_{i,t})D(Univ_{j,t,k})f(d_{i,j}) \quad (1)$$

where $F_{i,j,t,k}$ is the flow of students from province i who enrolled at a university's local unit j in year t in the field of study k; $O(Prov_{i,t})$ is the origin province's socio-economic characteristics, which shape outbound student mobility patterns; $D(Univ_{j,t,k})$ is the characteristics of the destination university's local unit and the socio-economic characteristics of the destination province; and finally, $f(d_{i,j})$ is a function of the travel distance or travel time between province i and the local unit j. To avoid potential bias, we artificially include the combinations of origin province, field of study and destination local unit for which no flows are observed in our dataset.

Our analysis is segmented based on the type of mobility flow: by necessity or by choice. We estimate each student flow as a function of impeding and attracting factors. To characterise the attractiveness of origin and destination provinces, we consider value added per capita and quality of life. Value added per capita captures economic productivity and is relevant because student mobility is likely to flow from less to more economically advanced areas (Dotti et al., 2013). Provincial rankings for quality of life, a composite index of well-being dimensions (e.g., wealth, services, environment, justice and culture), reflect the local living conditions. Mobility flows are frequently directed towards areas offering better amenities and institutional environments (Nifo & Vecchione, 2014). Regarding province of origin, we also consider both student population and the presence of prestigious institutions. Student population, measured as the number of residents enrolled in higher education, proxies demand: large student cohorts in provinces with limited higher education supply may stimulate outward mobility (Tuckman, 1970). The presence of prestigious, high-quality universities, proxied by their inclusion in the *Times Higher Education* (THE) international ranking, discourages student outflows from origin areas and thus reduces mobility (Türk, 2019). Conversely, the absence of such institutions encourages mobility towards prestigious destinations whose reputations act as signals of ability to employers (Ciriaci, 2014).[8]

We complement the origin and destination province attributes with the destination university or local unit's characteristics, such as student population, teaching resources, internationalisation, tuition fees, university type (public/private) and prestige. Student population – the number of students enrolled in a destination unit by field of study – indicates the strength of local higher education supply and institutional attractiveness, as large student concentrations often characterise educational hubs (Cattaneo et al., 2017b). Teaching resources, measured by the student-to-faculty ratio, reflect teaching quality: High ratios indicate limited instructional capacity and may reduce an institution's appeal (Ciriaci, 2014). Internationalisation, proxied by the share of international students, can enhance attractiveness by indicating an open, internationally oriented environment with services and infrastructures tailored to mobile students (Cattaneo et al., 2017b). In contrast, high tuition fees and private university status, associated with high selectivity, may deter mobility (Tuckman, 1970).[9] Lastly, university prestige – captured by inclusion and position in the THE ranking – increases incoming mobility flows, as higher ranked institutions tend to be more attractive to prospective students (Ciriaci, 2014). In THE ranking, universities receive exact rankings up to position 200; beyond this, they are placed into bands (e.g., 201–250), for which we compute average positions (e.g., 225). In the empirical analysis, the *university ranking inclusion* dummy is interacted with the *university ranking position* variable to isolate the effects of inclusion and relative position.

Lastly, we use road distance as a proxy for travel impedance between different provinces (Sa et al., 2004). We have retrieved provincial-level socio-economic data (corresponding to the NUTS-3 level classification) from the Italian National Institute of Statistics (ISTAT), except for the quality-of-life rankings, which are from the annual indexes of the Italian financial newspaper *Il Sole 24 Ore*. Data on universities and local units have been retrieved from USTAT or the THE ranking website.[10] Table 3 contains further information on the variables used.

Based on previous studies (Cattaneo et al., 2017b; Silva & Tenreyro, 2006), we use the Poisson pseudo-maximum likelihood technique to linearise equation (1). This approach is effective for problems related to the log-transformation of the gravity model when using an ordinary least squares (OLS) estimation, including the occurrence of zero values in the student flows and the heteroskedasticity of the error components. Equation (1) is linearised as follows:

$$F_{i,j,t,k} = \sum_{m=1}^{M} a_m \ln \mathrm{Prov}_{m,i,t} + \sum_{p=1}^{P} b_p \ln \mathrm{Univ}_{p,j,k,t} + \gamma \ln f(d_{i,j}) + \varepsilon_{i,k,t} \tag{2}$$

where M is the number of characteristics considered for the origin province; and P is the number of characteristics for the destination university's local unit and province. Fixed effects for years, study disciplines and provinces are incorporated into the model to account for unobservable elements that influence student mobility over time and between provinces.

Table 3. Variable descriptions.

Variable	Variable description
Mobility by choice	Flow of mobile students from a given province to a specific university local unit, despite at least one alternative university within a 90-min travel distance offering the same field of study
Mobility by necessity	Flow of mobile students from a given province to a specific university local unit when no alternative university within a 90-min travel distance offers the same field of study
Distance	Distance-decay parameter measured as the road distance between the legal residence of the destination university and the capital town of each origin province
Origin (province and university system features)	
Value added per capita	Value added per capita of the origin province
Quality-of-life ranking	Annual position of the origin province in *Il Sole 24 Ore*'s quality-of-life rankings
Student population	Total number of students residing in the origin province who are enrolled in higher education
Ranked university in the province	Dummy variable equal to 1 if the origin province has at least one university offering the specific field of study included in the *Times Higher Education* (THE) ranking; 0 otherwise
Destination (province and university features)	
Value added per capita	Value added per capita of the destination province
Quality-of-life ranking	Annual position of the destination province in *Il Sole 24 Ore*'s quality-of-life rankings
Student population per discipline	Total number of students enrolled in the destination local unit by field of study
University internationalisation	Percentage of international students among the total students enrolled in the destination university
University teaching resources	Student-to-faculty ratio measured as the number of students per professor at the destination university
University average tuition fee	Average tuition fee per student at the destination university, net of ancillary fees and accounting for fee exemption and reimbursement
University ranking inclusion	Dummy variable equal to 1 if the destination university is included in the THE ranking; 0 otherwise
University ranking position	Annual position of the destination university in the THE ranking
Private university	Dummy variable equal to 1 if the destination university is private; 0 otherwise

4. Results

4.1. Descriptive

Figure 2 illustrates the market shares of universities per region – that is, the proportion of students residing in a particular region who are enrolled in universities across different regions of Italy. The students' residential regions are given in the rows, and the university regions are given in the columns. Each cell indicates the percentage of students from a residential region (row) enrolled in a university located in a destination region (column). The colour and intensity of each cell reflects the relative size of the market share: intense red indicates an extremely high student percentage, while light green indicates a very low percentage. The student residence regions and university regions are ordered from the north to the south to visualise the main student mobility flows. Cells along the diagonal represent the share of enrolments within the region of residence. Cells distant from the diagonal indicate interregional mobility flows. Notably, the presence of coloured cells under the diagonal indicate significant student flows from the south to the north. Flows in the opposite direction (above the diagonal) are almost zero, indicating the limited ability of southern universities to enrol students residing in the north.

Several university regions on the diagonal exhibit a high concentration of enrolments from the same region, as indicated by the red cells. These include Piedmont, Lombardy, Emilia-Romagna, Tuscany, Lazio, Campania, Sicily and Sardinia. Universities in some of these regions, such as Piedmont, Lombardy, Emilia-Romagna and Lazio, have a high share of local students as well as students from nearly all regions of Italy. In contrast, universities in regions such as Valle d'Aosta and Basilicata display lower retention levels of students residing in the same region, as highlighted by the green cells. Figure A1 in Appendix A in the supplemental data online illustrates the market shares of single universities by province.

Figure 3 shows the geographical distribution of student mobility and the proportion of mobility by necessity by province. Figure 3a presents the proportion of mobile students among the total residing students, highlighting each province's mobility levels. For instance, Lombardy provinces account for less than 10% of mobile students, except for Sondrio (dark blue area in the north), with outbound mobility flows primarily directed towards Milan or Bergamo. Regions such as Sicily, Sardinia and Basilicata are characterised by a more homogeneous medium-to-high incidence of student mobility. Figure 3a shows the proportion of mobility by necessity among the total mobility flows. Notably, the majority of provinces are characterised by a high proportion of students moving by choice (whiter areas in Figure 3b). Only some provinces are

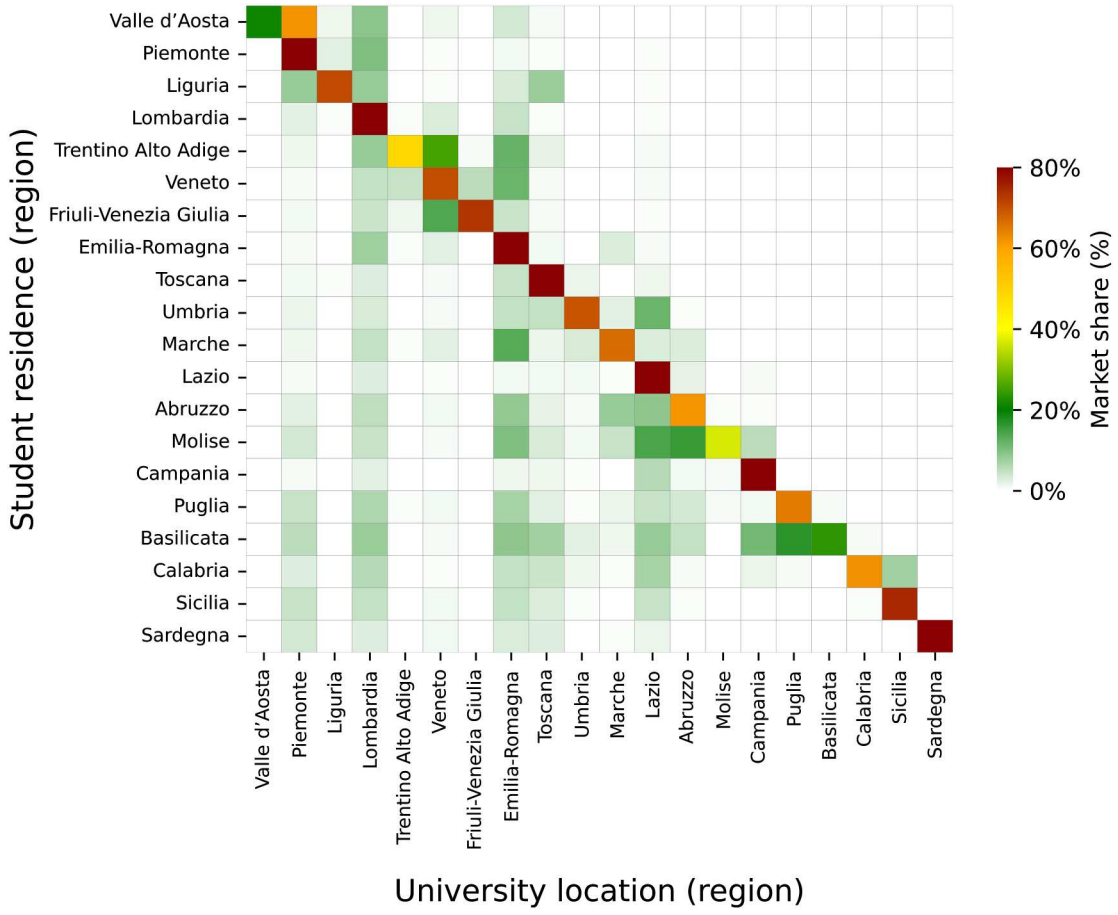

Figure 2. Student residence–university location matrix, 2022.

denoted by a high incidence of necessity-driven mobility, such as Aosta, Sondrio, Nuoro and Reggio Calabria. Overall, Figure 3 illustrates that student mobility is not spatially uniform across Italy and that mobility by choice and by necessity differ in scale and geographical distribution.

4.2. Main findings and discussion

Table 4 presents the main estimation results, distinguishing mobility by necessity (model 1) from mobility by choice (model 2). Some factors affect both similarly. Distance reduces student flows: An increase in 1 SD (standard deviation) decreases mobility by necessity and by choice by 14% and 9%, respectively, indicating that necessity-driven movers face greater geographical constraints.[11] Mobility by necessity increases by approximately 7%, compared with 3% for mobility by choice, when value added per capita of the destination area increases by 1 SD. Mobility flows from areas lacking local provisions for specific fields of study are disproportionately directed towards universities located in wealthier provinces (Bratti & Verzillo, 2019; Dotti et al., 2013, 2014). Likewise, both mobility flow types are more strongly associated with larger universities (in terms of student enrolment) and internationalised institutions. This pattern aligns with the broader availability of programmes offered by such universities, which is relevant for both necessity- and choice-driven mobility.

These findings underscore the complexity of student mobility decisions and indicate that policy interventions should account for the distinct determinants driving each type. Our remaining estimations further support this by highlighting the factors that influence both mobility flows in opposite ways, such as the destination's quality of life and tuition fees. Although mobility by necessity is shaped by economic factors, as explained by the variable *value added per capita*, it appears to be more linked to economic prosperity than to lifestyle-related characteristics. Notably, mobility flows by necessity are frequently directed towards

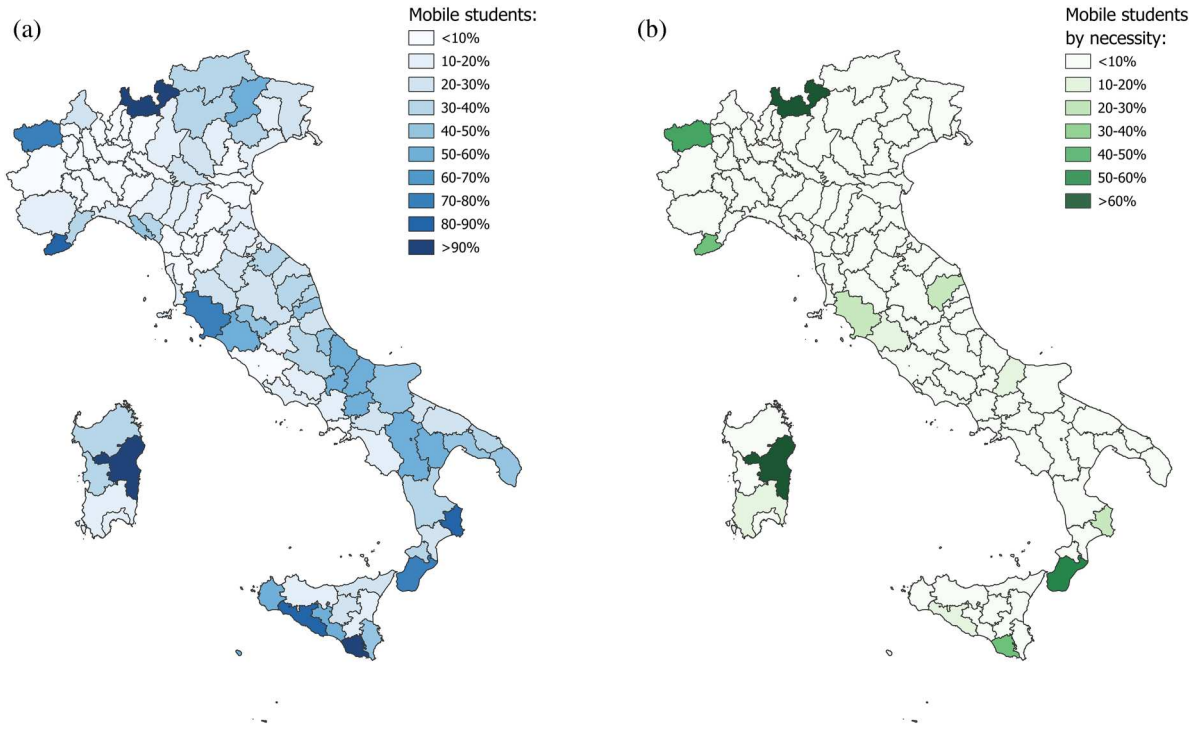

Figure 3. Percentage of mobile students by province in 2022: (a) the proportion of mobile students relative to the total number of resident students in each province; and (b) the share of mobility by necessity among the total outbound mobility flows from each province.

provinces characterised by a lower quality of life, as indicated by the positive coefficient of the variable quality-of-life ranking. The multifaceted nature of the quality-of-life index can explain such a seemingly counterintuitive result, as it includes economic, business, cultural and social dimensions. Overall, mobility by necessity's positive associations with value added per capita and quality-of-life ranking suggest that it is more strongly linked to economic opportunities than to broader well-being indicators, as flows are disproportionately oriented towards wealthier provinces despite potential drawbacks in non-economic dimensions. Mobility by choice exhibits the opposite pattern: flows are more strongly associated with provinces characterised by a higher quality of life, indicating that non-economic dimensions of well-being, such as lifestyle and cultural amenities, play a prominent role alongside educational considerations.

These findings have broad implications for understanding higher education participation. Students from disadvantaged territories may face high barriers to enrolment in fields of study requiring costly or long-distance mobility, potentially leading to reduced tertiary education attainment. Thus, mobility by necessity reflects not only the spatial redistribution of students but also uneven access to higher education opportunities across regions. This is also the case with tuition fees, which differentiate mobility by necessity from mobility by choice. Mobility flows by necessity are negatively associated with increased tuition fees; a 1 SD increase corresponds to a 5% reduction in mobility, consistent with the role of financial constraints (Cattaneo et al., 2017a; Tosi et al., 2019; Türk, 2019). Mobility flows by choice are positively associated with higher fee institutions, with mobility increasing by 2% per 1 SD increase, consistent with the 'flight to quality' argument (McCaig, 2016). Nevertheless, mobility by choice flows are negatively affected by private destination universities. This suggests that the positive association between tuition fees and mobility by choice may be bounded or that tuition fees at private universities may not proxy institutional quality in the same way as for public universities.

Other findings consistently indicate quality-oriented mobility patterns. The negative coefficient for university teaching resources suggests that mobility flows by choice are more strongly associated with institutions characterised by better learning conditions. Fewer students per faculty indicate uncrowded universities and positive learning conditions (Ciriaci, 2014). Mobility flows by choice are less frequent when the origin province hosts a ranked university offering required fields. According to the literature,

Table 4. Empirical results.

	Mobility by necessity (1)	Mobility by choice (2)
Distance	−1.992***	−1.867***
	(0.0708)	(0.0306)
Origin (province and university system features)		
Value added per capita	−0.196	−0.339***
	(0.571)	(0.107)
Quality-of-life ranking	0.0256	−0.0227**
	(0.0250)	(0.00882)
Student population	−0.162	0.798***
	(0.452)	(0.0984)
Ranked university in the province		−0.0409*
		(0.0222)
Destination (province and university features)		
Value added per capita	1.991***	1.022***
	(0.262)	(0.0625)
Quality-of-life ranking	0.148***	−0.107***
	(0.0558)	(0.0139)
Student population per discipline	1.007***	1.068***
	(0.0527)	(0.0139)
University internationalisation	7.332***	8.463***
	(2.232)	(0.434)
University teaching resources	0.258	−0.143***
	(0.196)	(0.0512)
University average tuition fee	−0.586***	0.286***
	(0.154)	(0.0463)
University ranking	−3.310***	−0.884***
	(0.866)	(0.184)
University ranking × University ranking position	0.526***	0.156***
	(0.142)	(0.0296)
Private university	0.200	−0.144**
	(0.218)	(0.0698)
Constant	−6.454	−11.85***
	(8.354)	(1.683)
Year fixed effects	Yes	Yes
Discipline fixed effects	Yes	Yes
Province fixed effects	Yes	Yes
Observations	55,785	1,142,256
R^2	0.559	0.397

Note: Robust standard errors are shown in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

students who can study in prestigious universities do not move (Ciriaci, 2014). Counterintuitively, mobility neither by choice nor by necessity is stimulated by the destination university rankings: mobility flows are predominantly directed towards unranked universities or lower ranked institutions. This may be because all universities' degrees hold the same legal value in Italy or because, in the entire period of analysis, only 20 Italian universities had a THE ranking and only three of them were among the top 200. This suggests that, conditional on mobility, ranking may not be the primary dimension for evaluating university quality.

4.3. Spatial perspective of student mobility flows

To further enrich the spatial analysis and account for Italy's pronounced territorial divides, we disaggregate our estimates by geographical direction, distinguishing flows by origin (Table 5) and destination (Table 6) macro-areas. Models 1–3 are for mobility by necessity and models 4–6 for mobility by choice, with flows from and to the north (models 1 and 4), centre (models 2 and 5) and south (models 3 and 6). This regional lens confirms the general model while revealing important local nuances potentially critical for place-based policy design. The regional dissection of origin macro-areas (Table 5) highlights a north–south divide. Mobility flows originating from the south are more strongly associated with destination economic conditions, as the positive coefficients of destination value added per capita in model 3 and 6 indicate. This pattern suggests that outbound flows from the south are closely linked to regional differences in economic

Table 5. Results by origin macro-area.

	Mobility by necessity			Mobility by choice		
	North (1)	Centre (2)	South (3)	North (4)	Centre (5)	South (6)
Distance	−4.603***	−4.613***	−1.867***	−2.941***	−3.046***	−1.717***
	(0.118)	(0.300)	(0.0772)	(0.0541)	(0.0777)	(0.0395)
Origin (province and university system features)						
Value added per capita	0.101	−1.365	−0.976	−0.270	0.227	−0.310***
	(1.162)	(2.581)	(0.754)	(0.330)	(0.343)	(0.120)
Quality-of-life ranking	0.0153	−0.103	−0.157	−0.0198**	0.00340	−0.171***
	(0.0361)	(0.0891)	(0.0974)	(0.00953)	(0.0132)	(0.0315)
Student population	0.378	2.076	0.0913	1.361***	0.181	0.717***
	(0.599)	(1.952)	(0.661)	(0.225)	(0.325)	(0.184)
Ranked university in the province				−0.0272	−0.00685	−0.00861
				(0.0420)	(0.0482)	(0.0250)
Destination (province and university features)						
Value added per capita	−1.942***	−0.128	1.882***	−1.751***	0.839***	1.380***
	(0.393)	(0.452)	(0.372)	(0.110)	(0.134)	(0.0878)
Quality-of-life ranking	0.0236	−0.139	0.0141	−0.226***	−0.104***	−0.0761***
	(0.0372)	(0.108)	(0.0763)	(0.0204)	(0.0201)	(0.0214)
Student population per discipline	1.636***	1.065***	0.993***	1.307***	1.220***	1.069***
	(0.109)	(0.128)	(0.0613)	(0.0254)	(0.0328)	(0.0188)
University internationalisation	−5.036***	17.30***	9.755***	7.526***	13.60***	8.263***
	(1.746)	(2.765)	(2.900)	(0.652)	(0.703)	(0.633)
University teaching resources	−1.028***	0.199	0.301	−0.666***	−0.195**	−0.0108
	(0.270)	(0.293)	(0.230)	(0.0892)	(0.0864)	(0.0631)
University average tuition fee	0.310	0.619**	−0.964***	0.377***	0.408***	0.0814
	(0.249)	(0.310)	(0.170)	(0.0788)	(0.0956)	(0.0579)
University ranking	3.379***	−3.379**	−3.863***	−0.295	−0.441	−1.948***
	(0.707)	(1.509)	(1.130)	(0.241)	(0.281)	(0.318)
University ranking × University ranking position	−0.543***	0.624***	0.585***	0.0632*	0.0815*	0.323***
	(0.117)	(0.241)	(0.184)	(0.0384)	(0.0454)	(0.0516)
Private university	0.220	−0.971*	0.554**	0.281**	−0.103	0.156*
	(0.306)	(0.514)	(0.244)	(0.130)	(0.151)	(0.0891)
Constant	28.19**	9.656	3.118	13.13***	−4.186	−14.31***
	(13.85)	(27.36)	(10.70)	(4.546)	(5.253)	(2.191)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Discipline fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,785	6285	28,715	495,194	242,620	404,442
R^2	0.867	0.810	0.573	0.500	0.539	0.415

Note: Robust standard errors are shown in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

prosperity. Economic conditions in the origin areas also matter for student mobility from the south. Mobility flows by choice occur more frequently from regions with lower levels of value added per capita (−0.310, $p < 0.01$, model 6), suggesting that weaker economic conditions in the south are associated with selective student outflows. The economic dimension's relevance is reflected by the negative coefficient of tuition fees (−0.964, $p < 0.01$, model 3) for mobility by necessity, aligning with the role of cost-related constraints in shaping observed mobility patterns.

Mobility from the north shows stronger association with institutional quality at destination regions, as indicated by the negative coefficients of university teaching resources in models 1 and 4. Institutional reputation is relevant for mobility by necessity, as flows are strongly associated with high-ranked universities (coefficient for ranking inclusion: 3.379, $p < 0.01$; coefficient for interactions with the ranking position: −0.543, $p < 0.01$). The tuition fees charged by institutions do not influence this mobility flow. Conversely, mobility flows by choice are more frequently directed towards institutions charging higher tuition fees (coefficient: 0.377, $p < 0.01$) but occupying lower ranking positions. This indicates that, for north-origin mobility, tuition-related and ranking-related dimensions of institutional quality play a differentiated role across mobility types. Mobility patterns originating from the centre resemble those originating from the south: They are positively associated with destination economic conditions (coefficient of destination value added per capita: 0.839, $p < 0.01$, model 5). These flows are also associated with higher tuition fees (coefficients: 0.619, $p < 0.05$, and 0.408, $p < 0.01$, models 2 and 5), indicating a lower sensitivity to tuition costs than that observed for mobility by necessity from the south.

Table 6. Results by destination macro-area.

	Mobility by necessity			Mobility by choice		
	North (1)	Centre (2)	South (3)	North (4)	Centre (5)	South (6)
Distance	−4.125***	−2.810***	−2.317***	−3.168***	−1.792***	−2.569***
	(0.166)	(0.269)	(0.105)	(0.0626)	(0.0792)	(0.0596)
Origin (province and university system features)						
Value added per capita	0.00988	−1.574**	−5.566***	−0.862***	−0.171	−3.422***
	(0.654)	(0.775)	(1.211)	(0.150)	(0.150)	(0.352)
Quality-of-life ranking	0.0954***	−0.0511	−0.476*	−0.0180*	−0.0515***	−0.240**
	(0.0332)	(0.0786)	(0.270)	(0.00946)	(0.0145)	(0.114)
Student population	−1.268***	0.317	0.262	0.303***	1.988***	0.479***
	(0.363)	(0.618)	(0.195)	(0.110)	(0.114)	(0.0450)
Ranked university in the province				−0.0427	−0.0360	0.277***
				(0.0274)	(0.0239)	(0.0723)
Destination (province and university features)						
Value added per capita	−1.266***	−2.741***	3.168***	−1.308***	−2.569***	2.515***
	(0.281)	(0.311)	(0.768)	(0.0785)	(0.141)	(0.450)
Quality-of-life ranking	0.0811***	−0.253***	−1.104***	−0.160***	−0.221***	−1.010***
	(0.0283)	(0.0725)	(0.196)	(0.0108)	(0.0211)	(0.153)
Student population per discipline	1.697***	1.555***	0.747***	1.487***	1.416***	1.151***
	(0.0710)	(0.0898)	(0.0800)	(0.0188)	(0.0302)	(0.0468)
University internationalisation	1.920	8.875***	45.90***	6.940***	6.480***	48.34***
	(1.889)	(1.962)	(15.17)	(0.464)	(0.646)	(8.090)
University teaching resources	−0.596**	−0.0578	1.291***	−0.161**	−0.303***	0.283
	(0.240)	(0.217)	(0.328)	(0.0652)	(0.0588)	(0.199)
University average tuition fee	−0.506**	0.987***	−1.436***	−0.210***	0.834***	−0.916***
	(0.232)	(0.293)	(0.191)	(0.0641)	(0.0859)	(0.109)
University ranking	−0.798	−5.362***	−11.07***	−1.119***	−1.733***	−10.50***
	(0.707)	(0.981)	(3.229)	(0.206)	(0.374)	(1.606)
University ranking × University ranking position	0.152	0.989***	1.727***	0.195***	0.335***	1.695***
	(0.117)	(0.161)	(0.516)	(0.0324)	(0.0610)	(0.257)
Private university	1.249***	−0.185	1.384***	1.222***	0.0953	2.437***
	(0.300)	(0.541)	(0.477)	(0.0960)	(0.172)	(0.212)
Constant	47.69***	38.61***	42.05***	32.22***	3.498	22.40***
	(9.317)	(10.61)	(16.08)	(2.076)	(2.611)	(6.066)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Discipline fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,730	12,047	20,008	470,162	259,791	412,303
R^2	0.646	0.700	0.659	0.544	0.565	0.360

Note: Robust standard errors are shown in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

The regional disparities are nuanced when considering destination macro-areas (Table 6). Higher levels of value added per capita in northern and central destination regions are negatively associated with mobility flows, as indicated by the negative coefficients of destination value added per capita in models 1–2 and 4–5. This pattern is consistent with the presence of economic constraints that may limit mobility towards wealthier areas. In contrast, the positive coefficient of destination value added per capita for flows directed towards the south indicates that mobility in this direction is strongly associated with destination economic conditions. Tuition fees are negatively associated with mobility flows to the north and the south but positively associated with mobility flows to the centre (coefficients: 0.987 and 0.834, $p < 0.01$, models 2 and 5), suggesting that tuition levels may proxy institutional quality, academic programmes or reception conditions in central regions. University prestige consistently displays negative associations across the destination macro-areas. In general, Table 4 shows that mobility flows in Italy frequently occur towards unranked or lower ranked universities.

Regarding the mobility types, mobility by necessity originating from provinces with high levels of value added per capita is negatively associated with flows towards the centre and the south (coefficient: −1.574, $p < 0.05$; −5.566, $p < 0.01$, respectively, models 2 and 3), while flows originating from provinces with high quality-of-life rankings are less frequently directed towards the north (coefficient: 0.095, $p < 0.01$). The first finding suggests that limited local economic support is associated with high mobility flows towards the centre and even higher towards the south. The second finding suggests that mobility flows towards the north are less common among students originating from areas with higher living standards, highlighting

the relevance of origin-level service provision in shaping mobility patterns. Notably, mobility flows by choice originating from economically disadvantaged areas are more strongly associated with destinations in the north (coefficient: −0.862, $p < 0.01$) and the south (coefficient: −3.422, $p < 0.01$).

4.4. Robustness checks

Table 7 presents several robustness test results for mobility by necessity (models 1–4) and by choice (models 5–8). Models 1 and 5 consider the estimations presented in Table 4 upon excluding the disciplinary areas with caps in student admissions (*numerus clausus*): medicine, dentistry, veterinary science, education and architecture. Caps are applied at the national level through a single entrance test and nationwide rankings established annually by the MUR. Students compete nationally, and admission is determined solely by their ranking, which may require them to relocate to an assigned university. For these fields of study, student mobility may be affected by supply constraints and exhibit varying patterns. The results of models 1 and 5 align with those of the main analysis (Table 4), except for the negative effect of enrolling in a private university, which is not statistically significant for mobility by choice when the *numerus clausus* disciplines are excluded.

For the other models in Table 7, the definition of mobile students changes, and the flows by choice and necessity vary accordingly. In models 2 and 6, a lower threshold of 60 min is considered, which mitigates the risk of underestimating the number of mobile students. Conversely, we use higher thresholds of 120 min in

Table 7. Robustness checks results.

	Mobility by necessity				Mobility by choice			
	No cap (1)	60 min criteria (2)	120 min criteria (3)	180 min criteria (4)	No cap (5)	60 min criteria (6)	120 min criteria (7)	180 min criteria (8)
Distance	−2.065***	−1.916***	−2.394***	−2.886***	−1.867***	−2.096***	−1.669***	−1.078***
	(0.0784)	(0.0304)	(0.116)	(0.304)	(0.0333)	(0.0233)	(0.0363)	(0.0445)
Origin (province and university system features)								
Value added per capita	0.110	−3.685***	0.0880	0.0219	−0.405***	−0.551***	−0.424***	−0.565***
	(0.553)	(0.186)	(0.641)	(3.894)	(0.120)	(0.101)	(0.117)	(0.133)
Quality-of-life ranking	0.0281	−0.370***	−0.00169	0.361	−0.0177*	−0.00315	−0.0369***	0.00181
	(0.0248)	(0.0370)	(0.0206)	(0.454)	(0.00991)	(0.00726)	(0.00942)	(0.0123)
Student population	−0.187	0.785***	−1.776***	−3.285	0.626***	0.378***	1.457***	1.759***
	(0.463)	(0.0547)	(0.631)	(5.492)	(0.102)	(0.0985)	(0.107)	(0.129)
Ranked university in the province					−0.0637**	−0.0731***	−0.0335	−0.0366
					(0.0248)	(0.0211)	(0.0225)	(0.0238)
Destination (province and university features)								
Value added per capita	1.945***	0.529***	1.952***	4.584***	0.963***	1.155***	0.935***	1.027***
	(0.267)	(0.116)	(0.369)	(0.708)	(0.0648)	(0.0598)	(0.0668)	(0.0584)
Quality-of-life ranking	0.145**	−0.0787***	−0.0152	0.842***	−0.112***	−0.0794***	−0.120***	−0.0688***
	(0.0571)	(0.0268)	(0.0735)	(0.180)	(0.0148)	(0.0140)	(0.0143)	(0.0130)
Student population per discipline	1.052***	0.971***	1.121***	1.286***	1.069***	0.981***	1.153***	1.205***
	(0.0534)	(0.0243)	(0.0708)	(0.150)	(0.0154)	(0.0124)	(0.0146)	(0.0160)
University internationalisation	7.541***	6.394***	4.405	14.05***	9.164***	7.727***	8.652***	7.576***
	(2.319)	(1.120)	(3.010)	(3.955)	(0.481)	(0.478)	(0.459)	(0.493)
University teaching resources	0.152	−0.142	0.313	1.003***	−0.127**	−0.0182	−0.103**	−0.0706
	(0.184)	(0.0925)	(0.249)	(0.345)	(0.0544)	(0.0501)	(0.0512)	(0.0524)
University average tuition fee	−0.601***	−0.342***	−1.269***	−1.017**	0.273***	0.231***	0.322***	0.266***
	(0.157)	(0.0750)	(0.180)	(0.467)	(0.0474)	(0.0440)	(0.0469)	(0.0521)
University ranking	−3.916***	−1.715***	−4.525***	−10.13***	−0.539**	−0.721***	−1.233***	−1.272***
	(0.870)	(0.425)	(0.932)	(2.138)	(0.210)	(0.179)	(0.215)	(0.227)
University ranking × University ranking position	0.633***	0.284***	0.722***	1.695***	0.104***	0.139***	0.222***	0.219***
	(0.141)	(0.0693)	(0.149)	(0.346)	(0.0341)	(0.0288)	(0.0350)	(0.0369)
Private university	0.225	−0.0626	0.959***	1.165*	−0.0850	−0.326***	−0.0365	0.0115
	(0.228)	(0.118)	(0.294)	(0.666)	(0.0715)	(0.0697)	(0.0726)	(0.0833)
Constant	−8.106	34.19***	6.598	−10.20	−9.479***	−5.768***	−20.41***	−24.14***
	(8.429)	(2.163)	(11.21)	(78.56)	(1.642)	(1.561)	(1.776)	(1.810)
Observations	54,853	219,820	26,211	2371	978,636	1,022,865	1,112,840	984,244
R^2	0.577	0.565	0.650	0.730	0.365	0.526	0.438	0.397

Note: Robust standard errors are shown in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

models 3 and 7 and 180 min in models 4 and 8, which reduces the number of students classified as mobile. The results are robust to each definition of mobile students.

Nevertheless, a few noteworthy patterns can be observed, especially for mobility by necessity. First, these tests highlight a strong association between distance and mobility flows by necessity compared with mobility by choice, as demonstrated by the growing magnitude of coefficients with increasing distance (coefficients: −1.916, $p < 0.01$, in model 2; −2.394, $p < 0.01$, model 3; −2.886, $p < 0.01$, model 4; distances of 60, 120 and 180 min, respectively). This result is consistent with an economic interpretation: Greater distances are associated with higher mobility-related costs and, in turn, negatively associated with mobility by necessity (Gibbons & Vignoles, 2012; Sa et al., 2004). For mobility by choice, the negative association with distance weakens as the travel time threshold increases, indicating that longer distance flows occur more frequently when mobility is not constrained by proximity. Second, the value added per capita of the destination province is particularly important for mobility flows by necessity with the 180-min threshold (model 4). This pattern suggests that long-distance mobility is strongly associated with improved economic conditions of destinations, as shown by Dotti et al. (2013). Third, an interesting pattern emerges regarding tuition fees. The strongest negative association is with mobility flows by necessity over 120 min. At the 180-min threshold, the effect remains statistically significant but is weakened compared with 120 min. This attenuation is consistent with the idea that, at longer distances, mobility flows are increasingly shaped by additional cost components embedded in the distance measure, including non-monetary dimensions related to spatial separation (Türk, 2019).

5. Conclusions

In this study, we examined the different types of domestic student mobility using Italian data from the 2011–22 period. We used a gravity model to frame the analysis at the field-of-study level instead of the more traditional university–province level and thus accounted for variability across fields of study within a single university location unit. The model's estimates revealed distinct determinants of the two mobility types. Mobility flows by necessity are more strongly associated with distance and tuition fees, consistent with the role of economic constraints and relocation costs previously documented (Cattaneo et al., 2017a; Marinelli, 2013), which include housing and travel-related expenses associated with long-distance mobility (Gibbons & Vignoles, 2012; Sa et al., 2004). Mobility flows by choice have stronger associations with universities characterised by higher tuition and teaching resources, aligning with the 'flight to quality' argument (McCaig, 2016). Both mobility types, especially mobility by necessity, are positively associated with destinations with high value added per capita (Dotti et al., 2013). Only mobility by choice is significantly associated with quality-of-life indicators, with flows strongly directed towards high-quality locations in terms of cultural and social amenities and overall living conditions (Nifo & Vecchione, 2014), while mobility by necessity is associated with lower quality destinations. This mirrors international student flows: mobility from less developed countries is frequently directed towards higher quality educational destinations, while flows from wealthier regions are more closely associated with amenities and leisure-related factors (Civera et al., 2023; Van Bouwel & Veugelers, 2013).

This study contributes to the regional studies literature by showing how student mobility reflects and reinforces territorial inequalities in access to higher education. Differentiating between mobility by choice and by necessity shows how place-based constraints shape higher education participation and highlights the mechanisms underlying Italy's persistently low tertiary education attainment, particularly structural barriers that affect peripheral and economically disadvantaged areas, and ultimately the distribution of human capital across regions. Understanding mobility drivers is crucial for local communities to attract talent (Dotti et al., 2013), universities to shape strategies (Cattaneo et al., 2017b) and policymakers to design support mechanisms (Vergolini & Zanini, 2015). Universities should recognise that international profiles (e.g., English-taught courses) make certain fields more attractive. Students can also benefit from our study, as it clarifies the incentives and constraints affecting relocation choices (Gibbons & Vignoles, 2012; Sa et al., 2004).

Our distinction between mobility arising from limited local availability of study options and mobility occurring despite the presence of local alternatives (Mixon, 1992a, 1992b; Tuckman, 1970) allows for precisely identifying economic, institutional and policy incentives and underscores the need for differentiated support

mechanisms. Our dual-perspective framework can aid targeted interventions that balance equity and excellence in providing access to higher education. Practically, our refined definition of mobile students based on travel time rather than administrative boundaries or self-reported residency better captures accessibility constraints, addressing the MUR's potential overestimation of mobile students while accounting for regional and provincial disparities in travel conditions. Our improved classification approach can help policymakers direct financial aid to those facing genuine mobility barriers and enable universities and regional authorities to refine their strategies for campus expansion, housing and transport subsidies. This method also offers a benchmark for refining other countries' student mobility analyses. Many higher education systems face similar challenges, and a travel time-based approach provides a replicable, adaptable framework for diverse geographical and institutional contexts. Our enhanced mobility assessment approach can inform future studies and policy refinements for improving student flow management and equitable university access.

A number of illustrative and conditional policy considerations arise from the patterns observed in this study. First, the distinction between mobility by choice and necessity emerges as a relevant dimension in determining student support policies. Trends in mobility by necessity highlight persistent territorial disparities and raise questions about how financial support systems might address unequal access to higher education across regions. From this perspective, policies aimed at ensuring that students from marginalised areas are not constrained by geography warrant particular attention. Conversely, mobility by choice, which is associated more with the pursuit of high-quality institutions, indicates the role of regions and universities in shaping mobility patterns through institutional strategies and territorial attractiveness. Greater institutional or regional involvement in managing incoming flows could, in principle, contribute to more balanced academic ecosystems, provided that transparent and well-defined criteria are established to avoid unintended consequences such as overcrowding and quality dilution. Second, the differentiating between the mobility types provides a useful lens for reflecting on financial aid system design. While we did not evaluate specific policy instruments, the analytical results are consistent with the idea that income-based support is particularly relevant for necessity-driven mobility and merit-based criteria more salient for choice-driven mobility. Without this distinction, financial aid systems may disproportionately benefit students who are already well resourced. Third, the spatially concentrated student flows observed in the data suggest that capacity-related considerations matter for the higher education system's long-term sustainability. Measures such as enrolment management or inter-institutional coordination could be explored to balance out the pressure on highly attractive universities and support institutions facing weaker demand. Overall, the empirical patterns documented in this study may inform broader discussions on equity, efficiency, and territorial balance in higher education systems, in line with the principle given in Article 34 of the Italian Constitution that capable, deserving students should have access to the highest education levels regardless of financial resources.

This study is not without limitations. First, without municipal-level data, we approximated travel time and distance by province, potentially introducing errors, especially in areas with significant intra-provincial disparities. More granular data at the municipal or household level could improve the accuracy of future research. Second, we analysed aggregate student flows rather than individual choices, which captured broad patterns but overlooked heterogeneity in individual decision-making processes. Thus, we identified flows of students who had already decided what and where to study, but we could not model students' preferences based on multiple sets of alternatives. Moreover, we could not determine whether students prioritise the field of study or institution when making enrolment decisions. The literature lacks clear evidence on the sequentiality of students' choices; therefore, this is a promising research avenue. Addressing this limitation requires detailed microdata that are not publicly available. Third, our analysis was based on the assumption that the programmes in a field of study are perfectly substitutable. For instance, in the industrial engineering and manufacturing field, we assumed that mobile students enrolled in industrial engineering programmes have the same preferences, behaviours and determinants as those of mobile students enrolled in manufacturing. Further, we could not account for preferences towards specific programmes within each field using publicly available data. We also didn't explicitly account for financial constraints, social networks or cultural preferences, which likely influence mobility decisions. Future research could integrate survey data or experimental methods to explore these factors alongside institutional quality and spatial accessibility. Some mechanisms described herein, such as the relevance of economic prosperity for necessity-driven mobile students and quality of life for choice-driven mobile students,

could be further investigated. In particular, looking into unemployment rates could help disentangle job availability from general economic well-being, and deconstructing the quality-of-life index into its individual components could allow for distinguishing cultural amenities from business-related dimensions and social and living conditions. Including other university characteristics, such as graduation rates and student satisfaction, in future analyses could provide additional insights into the perceived quality of universities. The literature shows that university quality can influence students' decisions to migrate, as institutional reputation serves as a quality signal to employers (Ciriaci, 2014). Fourth, our findings are context specific, and their applicability to other higher education systems remains uncertain. Comparative studies across countries with different funding models and governance structures could provide valuable insights into how policies shape student mobility. These and other aspects are left to future research, which could further refine and expand the understanding of student mobility dynamics.

Notes

1. A threshold below 90 min may overestimate the phenomenon by including commuters in the definition of mobile students, whereas adopting a higher threshold may underestimate it by considering long-distance mobility only. Nevertheless, we have tested different thresholds for robustness (see Section 4.4).
2. Universities for foreigners constitute a specific category of public universities, historically established with the primary focus of teaching Italian language and culture to international students.
3. Private universities enjoy greater autonomy and may be more selective. For instance, Bocconi and LUISS offer Economics and Law programmes with a compulsory and strict entrance examination.
4. The fields are: Education; Arts; Humanities; Languages; Social and Political Sciences; Psychology; Economics and Business; Law; Natural Sciences, Mathematics and Statistics; Information and Communication Technologies; Architecture and Construction Engineering; Industrial Engineering and Manufacturing; Agriculture, Forestry, Fisheries and Veterinary; Health and Welfare; and Sport Sciences.
5. The decline in student enrolment in public universities has been offset by an increase in enrolments in long-distance universities and an increase in the number of international students.
6. A limitation of the current approach is that it overlooks the spatial distribution of students within their residential provinces because of the granularity of the USTAT data, which are not available at the municipal level. A possible solution is to use population density to proxy student distribution within each province and thereby compute population-weighted travel times and distances to universities' local units. This approach would add precision but requires collecting a huge amount of data on municipality–university location pairs. Considering this and the fact that the population fulcra of Italian provinces are typically located near the capital town, we assume that the proposed approach (i.e., considering the travel time between the capital town of their province of residence and university local unity) retains the core insights of the analysis while being more streamlined.
7. The three semi-public universities are not excluded. They are more similar to public universities than private-owned ones, as their tuition fees align with those of public institutions, and their proportion of income derived from student contributions is comparable with that of public universities.
8. For mobility by necessity, students have no universities – ranked or otherwise – offering their field of study within their province. This variable is therefore omitted in the necessity models.
9. Due to data limitations, average tuition fees are computed at the university level rather than at the field-of-study level. Accordingly, this variable should be interpreted as capturing the effects of the average tuition fee at the university level rather than field-specific variations.
10. See https://www.timeshighereducation.com/.
11. All percentage effects refer to dependent variable changes associated with a 1 SD increase in the corresponding covariate, holding all other variables constant.

Author contributions

CRediT: **Nicolò Avogadro:** Data curation, Methodology, Writing – original draft, Writing – review & editing; **Alice Civera:** Formal analysis, Methodology, Writing – original draft, Writing – review & editing; **Antonio Di Donato:** Resources; **Michele Meoli:** Methodology; **Stefano Paleari:** Conceptualization, Supervision.

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Ethics statement

This study did not require ethical approval or informed consent.

ORCID

Nicolò Avogadro http://orcid.org/0000-0002-6523-5041
Alice Civera http://orcid.org/0000-0002-1611-7073
Michele Meoli http://orcid.org/0000-0002-9438-0782

Data availability statement

The data that support the study findings are available from the corresponding author upon reasonable request.

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