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Brain gain versus brain drain: the effects of universities' mobile students on territorial inequalities

Ivan Etzo[a], Raffaele Paci[a] and Cristian Usala[b]

ABSTRACT

This study examines the relationship between university student mobility and local economic dynamics. Universities shape societies and economies as hubs of knowledge creation and innovation. While recent research highlights the significant impact of university students on local development, there is a gap in understanding the distinct effects of mobile versus resident students. Using data from 90 NUTS-3 provinces in Italy (2013–19), we investigate spatial inequalities generated by students' mobility. Employing a fixed effects growth model, we find that incoming students boost economic growth in the Centre–North regions (brain gain), while southern provinces suffer reduced growth due to the brain drain.

KEYWORDS

mobile university students; brain drain; spatial disparities; growth model

JEL C23, I25, J61, O47, R11

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1. INTRODUCTION

Universities play a crucial role in shaping local societies and economies, serving as dynamic hubs of knowledge creation, dissemination and innovation. Beyond their traditional function as centres of higher learning, universities operate as engines of economic growth, driving innovation, fostering entrepreneurship and supplying a skilled workforce to meet the demands of evolving industries (Drucker & Goldstein, 2007; Uyarra, 2010). Moreover, universities often serve as cultural and intellectual centres within their communities, fostering a vital ecosystem of ideas, creativity and collaboration. The presence of universities in the territory contributes to the socio-economic development of the regions in which they are located (Marrocu et al., 2022; Valero & Van Reenen, 2019).

More recently, a separate body of research has delved into the distinct impact that university students have on local development (Breznitz et al., 2022). As focal points for higher education and innovation, universities draw in a substantial influx of students from various regions and countries. This influx, in turn, impacts the local economy through different channels. First, they carry income from the origin economy, which is spent on goods and services in the host region, thereby activating the multiplier effect. Second, university students often look for part-time jobs, raising the labour supply of sectors such as hospitality, retail and services (Carrascal Incera et al., 2022). Third, an increasing number of firms are created by or with the collaboration of university students. In this regard, as mobile students are reported to be more talented than stayers, they are more likely to contribute to enriching the entrepreneurial culture of host regions (Breznitz et al., 2022; Wu & Eesley, 2022; for the case of Italy, see Columbu et al., 2021b; and Tosi et al., 2019). Ultimately, mobile university students enrich local communities with diverse perspectives and cultural experiences, fostering diversity, attracting businesses, and stimulating the arts, which enhances the area's appeal and contributes to economic growth (Florida, 2002; Marrocu & Paci, 2013; Ottaviano & Peri, 2006). Despite these recent developments in the literature, there is still much research to be done to assess the impact of the inflow of university students on the local economic system.

We contribute to this stream of literature by analysing how university mobile students contribute to the economic dynamics in the territory where they decide to move to attend university courses. Moreover, we assess whether the effects of mobile and resident students on the local economy differ.

Our empirical analysis focuses on Italy, examining 90 NUTS-3 areas from 2013 to 2019, before the COVID-19

CONTACT Ivan Etzo ietzo@unica.it
[a] Department of Economics and Business, University of Cagliari and CRENoS, Cagliari, Italy
[b] Department of Social and Political Sciences, University of Cagliari and CRENoS, Cagliari, Italy
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pandemic. Italy presents an interesting case study due to its well-defined and persistent spatial pattern of student mobility with the consequent long-term structural brain drain, which contributes to determining the ongoing development gap of the Mezzogiorno (Ciriaci, 2005; Dotti et al., 2013). There is a substantial and increasing flow of talented students moving from southern provinces to the universities in the Centre–North regions (Attanasio, 2022; Ciriaci, 2014; Columbu et al., 2021b). Between 2010 and 2022, the southern regions lost, on average, 22% of high-school leavers to central and northern institutions, while attracting only 1.6% of students from the Centre–North. This trend has worsened over time, with the percentage of students migrating from the South increasing from 20% in 2010 to 25% in 2022.[1] This spatial pattern also interests the graduated student flows analysed in our study. Between 2013 and 2019, an average of 24.7% of first-level graduates from southern universities enrolled in a master's degree in the Centre–North, while only 0.6% of graduates moved in the opposite direction. This graduate outflow phenomenon is especially relevant for southern regions' local development considering that a large share of these mobile students, once graduated, integrate into the local workforce (AlmaLaurea, 2021), strengthening the economy of the northern provinces (brain gain) while simultaneously depleting opportunities in the southern regions (brain drain). Consequently, student mobility exacerbates the enduring spatial disparities within Italy.

Thus, a more specific research question is to investigate the spatial inequalities generated by student mobility. Accordingly, we analyse the impact of both incoming and outgoing students on the gross domestic product (GDP) per capita growth rate of Italian NUTS-3 regions. Furthermore, we assess whether the northern provinces benefit from a brain gain instead of a brain drain suffered by the southern areas due to student outflows. Lastly, we compute the additional contribution of student mobility to the existing income gap between the South and the Centre–North of Italy over the considered period.

Another novelty of our analysis is that we focus on the mobility flows of students who have completed a first-level degree and chosen to pursue a second-level degree in a different Italian province. Section 3.1 provides a detailed definition of these mobile students. Unlike Ballarino et al. (2022), who examine first-level students, we concentrate on second-level students because they are closer to entering the labour market and, therefore, have a more immediate impact on the economic performance of the destination region (Dotti et al., 2013).

The empirical model is based on a standard fixed effects growth model where the province's per capita GDP growth rate depends on the inflows and outflows of mobile students while controlling for other characteristics of the local economy, such as resident students, initial GDP conditions and population density.

Our results show that in Italy incoming students have a notably positive and significant impact on the economic growth of the province where they study. This effect is especially pronounced in the Centre–North regions, where the influx of students contributes to a 'brain gain' phenomenon. On the other hand, in the southern provinces, the departure of talented university students leads to a 'brain drain', resulting in reduced local growth rates.

The remainder of the paper is organised as follows. Section 2 reviews the recent literature on the determinants and the effects of students' mobility defining the conceptual framework of our analysis. Section 3 focuses on mobility students data, our variable of interest. Section 4 discusses the empirical growth model and the estimation results, with specific attention paid to spatial inequalities. Additionally, it presents the results of some robustness analyses. Section 5 presents an extension based on the income levels. Section 6 concludes.

2. BACKGROUND LITERATURE

In the knowledge-based economy, universities play a vital role in shaping the educational and technological landscape while contributing to the socio-economic development of the regions in which they are located (Valero & Van Reenen, 2019). A substantial body of literature (Drucker & Goldstein, 2007; Uyarra, 2010) highlights the complexity and differentiation of university functions, which can be categorised into three main objectives: teaching, research and the 'third mission'.[2]

Focusing specifically on innovation activities, Etzkowitz and Leydesdorff (1995) introduced the concept of the Triple Helix, which refers to the dynamic interplay between three key actors in innovation: universities, industry and government. The central premise of this concept is that innovation emerges from the continuous and overlapping interactions among these institutions, working together to foster knowledge-based economic development in the area.[3] The complexity of these interactions is further emphasised in the regional innovation system approach (Asheim et al., 2011), which underscores the pivotal role that universities play within local innovation ecosystems. Thus, universities fulfil a vital role in shaping regional environments, serving as 'engaged' or 'civic' institutions through their multifaceted contributions (Uyarra, 2010).

Stronger bonds between government, universities and private business systems enhance the innovation capacity of the local ecosystem. High-quality institutions contribute to the efficiency and effectiveness of both universities and firms. A well-established and renowned university not only generates and disseminates knowledge within the local community but also benefits from a dynamic and structured local economy. As our empirical analysis will demonstrate, these dynamics vary significantly across Italian regions. Consequently, the potential to leverage these virtuous interactions among institutions differs widely, exacerbating the regional divide between northern and southern Italy.

The literature has extensively examined the impact of university activities on local economic performance, particularly focusing on their effects on GDP per capita growth (see the recent literature review by Brekke,

2021). Notable studies include those by Goldstein and Renault (2004), Lendel (2010) and Drucker (2016) on US counties and states; Schubert and Kroll (2016) on German NUTS-3 regions; and Agasisti et al. (2019) on labour market areas in Italy. Additionally, several studies conduct cross-country analyses of GDP impacts, including the seminal contribution of Valero and Van Reenen (2019), which examines 1500 regions globally, and those by Agasisti and Bertoletti (2022) and Lilles and Rõigas (2017), which focus on European NUTS-2 regions. A different approach is taken by Marrocu et al. (2022), who analyse both the direct and indirect effects of universities' presence on total factor productivity across 270 regions in the European Union.

Another branch of the literature focuses on the specific contribution of university students to local economic performance (see the recent special issue of *Regional Studies* by Breznitz et al., 2022). As centres of higher learning and innovation, universities attract a significant influx of students from other regions and nations, who contribute to the growth of their host communities through their impact on spending, employment, entrepreneurship and knowledge spillovers. University students, particularly those living away from their hometowns, create a substantial demand for goods and services in the local economy. Their presence contributes to increased consumer spending across various sectors, including accommodation, transportation, groceries, entertainment and leisure activities. This heightened demand stimulates growth in local businesses, such as restaurants, retail stores and service providers, leading to a positive multiplier effect on the economy and generating additional job opportunities for the local workforce (Carrascal Incera et al., 2022). In addition, many inflow students seek part-time jobs (particularly in sectors such as hospitality, retail and services) to support their studies and living expenses, further boosting local employment and production. In contrast, local students, who often have established living arrangements, such as residing with their family, may not generate significant additional effects on local spending.

Moreover, university campuses often serve as hotspots for entrepreneurial activities (Bergmann et al., 2016; Pugh et al., 2018), aligning with the Triple Helix model. The academic environment, combined with access to research facilities and potential collaborators, encourages students to explore entrepreneurial ventures. This entrepreneurial culture leads to the generation of new ideas and discoveries, diversifying the local economy, and fostering knowledge spillovers within the community (Ponds et al., 2010; Varga, 2009). Collaboration and knowledge transfer between students, faculty, and local businesses can enhance productivity gains and competitiveness in the local economy (Benneworth & Hospers, 2007; Pugh, 2017). Many successful start-ups have emerged from university campuses, bringing innovations and job opportunities to the local economy. In the Italian context, Chiarello et al. (2020) provide a comprehensive analysis of the entrepreneurial activities of university students and graduates between 2004 and 2019. Their findings indicate that most graduates and students establish new firms or invest in existing enterprises in the same region where they obtained their degree. Moreover, compared with the overall national distribution of new firms, those founded by university students and graduates are more frequently established in the south of the country. Additionally, the role of universities in fostering innovative start-up creation and performance in Italy is explored by Del Bosco et al. (2021) and Modina et al. (2023). Their results show that while the local stock of human capital is positively associated with both innovative start-up birth rates and firm performance, the mere concentration of universities in a region does not exert a significant positive effect on fostering innovative start-ups.

Another important impact of mobile university students on local communities is the diversity of perspectives and cultural experiences they bring. This cultural exchange enriches the local social structure by fostering diversity, promoting intercultural exchanges, and attracting businesses interested in engaging with a cosmopolitan community. The fusion of cultures can also stimulate the local arts and entertainment scene, generating a creative environment that enhances the area's attractiveness and contributes to its broader economic development (Florida, 2002; Marrocu & Paci, 2013; Ottaviano & Peri, 2006).

A further link between the influx of students and local GDP growth lies in the retention of talent. Research on the Italian case has shown that students with stronger academic performance exhibit a higher tendency to migrate during their university careers (Ballarino et al., 2022; Enea, 2018; Tosi et al., 2019; Usala et al., 2023). These talented mobile students are drawn to renowned universities and educational institutions that offer high-quality education and research opportunities, benefiting the host regions through their arrival (Cattaneo et al., 2017). The phenomenon of interregional student mobility is particularly relevant in Italy, where student migration patterns have exhibited a consistent and well-defined spatial trend over an extended period. Specifically, there is a substantial, persistent and increasing outflow of skilled students from southern provinces to universities in northern Italy (as highlighted by Ciriaci, 2005, and more recently by the collection of papers in Attanasio, 2022). We now briefly review the literature on the determinants of student mobility, paying specific attention to the Italian case. To simplify the exposition, we distinguish between three categories: macro-factors (regional socio-economic conditions), meso-factors (characteristics and quality of the hosting universities), and micro-factors (individual characteristics and background of students and families), although many studies consider these factors in combination.

One branch of the literature focuses on macro-determinants of student mobility, highlighting the role of the socio-economic condition of hosting territories. After completing their studies, mobile students may choose to stay and work in their study region, especially if they find suitable job opportunities or decide to start their businesses (Fini et al., 2022). Mobile students tend

to stay outside their home region after graduation, favouring the same geographical area where they studied (Dotti et al., 2013, for Italy; Haapanen & Tervo, 2012, for Finland). This tendency is more pronounced among high-performing students compared with their low-performing peers (Tosi et al., 2019, for Italy; Oggenfuss & Wolter, 2019, for Switzerland). Using a gravity model, Dotti et al. (2013) analyse the characteristics of university student mobility flows across Italian provinces, finding that student mobility is positively influenced by university quality and local labour market conditions, particularly the availability of graduate job vacancies in destination regions. In a related study, Dotti et al. (2014) stress the positive impact of labour market dynamics in northern Italy in attracting students pursuing degrees in science and technology. Expanding on these findings, Giambona et al. (2017) employ a Bradley–Terry modelling approach to assess the attractiveness of competing territories for tertiary education. Their results indicate that universities' characteristics such as the share of government financial support, the quality of student services, and the number of available degree programmes significantly improve territories' attractiveness. Moreover, their analysis confirms that both the quality of the educational supply and territories' socio-economic conditions (e.g., labour market expectations) jointly shape student mobility, contributing to the general tendency of students from southern regions to migrate toward the more developed Centre–North of the country.

Giambona et al. (2017) expand on this by considering a broad range of determinants, including the characteristics of regions and the universities' financial resources and services available to students.

A second stream of the literature primarily focuses on the characteristics of host universities, emphasising how research quality can positively influence student enrolment (Bratti & Verzillo, 2019; Ciriaci, 2014), particularly at high-ranking institutions (Biancardi & Bratti, 2019). Additionally, factors such as the quality of mentoring services, infrastructure and overall student satisfaction contribute to a university's attractiveness (Gibbons et al., 2015). Beyond institutional quality, students' location preferences are shaped by various factors that impact the cost of enrolment, including tuition fees (Hübner, 2012; Murphy et al., 2019), supportive policies for disadvantaged students (Castleman & Long, 2016; Dynarski et al., 2021), and the availability of transport infrastructures (Cattaneo et al., 2016).

A third stream of literature examines the role of individual and family characteristics in shaping students' propensity to move to other regions for university education. This micro-level approach draws on themes from labour migration literature, such as the costs and returns of migration (Sjaastad, 1962) and the 'social escalator' theory (Fielding, 1992). Rational students – and their families – compare the costs and risks of attending the university in a region different from where they live with the potential benefit of moving to areas with better labour prospects and social advancement (Holdsworth, 2009). Therefore, student flows represent a critical element in shaping social and spatial mobility within a country. In the case of Italy, individual choices as determinants of students' mobility have been explored by Tosi et al. (2019), who demonstrated that individual skills, measured by high-school graduation marks, positively influence interregional student mobility. Their analysis also considers family background and regional characteristics. Impicciatore and Tosi (2019) further investigate the role of family background, particularly parental education, on students' decisions to move to northern universities. They find that higher parental education levels increase the likelihood of migration, primarily due to better access to financial resources. Conversely, less-advantaged students are more likely to enrol in universities within their home regions, as they face greater barriers to accessing higher education (Türk, 2019). Ballarino et al. (2022) explore the micro-determinants of student mobility across the Italian provinces, showing that factors such as social class, gender and prior school performance significantly influence mobility. D'Agostino et al. (2019) attempt to bridge the macro- and micro-approaches, demonstrating that both individual student characteristics and territorial differences are significantly and positively associated with the likelihood of enrolling in a northern university.

Promising socio-economic conditions in host territories provide attractive career prospects for graduates, encouraging them to remain and contribute their expertise to the local workforce. Accordingly, regions can position themselves as hubs for talent and innovation by leveraging their educational institutions, creating attractive job opportunities, fostering innovation, promoting community engagement and implementing supportive policies. This process often leads to a 'brain gain' for the destination region, which simultaneously causes a 'brain drain' in the regions from which students migrate. In the 'brain gain' virtuous circle, the host territory develops an ecosystem that attracts, develops, and retains skilled individuals through job opportunities and entrepreneurship retention (Kitagawa et al., 2022). The sustained presence of highly skilled individuals not only boosts the local economy but also enriches the community's social and cultural fabric, fostering long-term growth and prosperity (Faggian et al., 2017). Conversely, a 'brain drain' vicious cycle emerges in the regions from which students emigrate. These areas experience a depletion of talent, reduced job opportunities, decreased innovation, and lower economic performance. This negative effect is particularly pronounced in more peripheral regions, where institutions must overcome the deterrent effect of geographical distance to attract and retain students (Spiess & Wrohlich, 2010; Suhonen, 2014).

In relation to our research question, it is important to note that in Italy, the majority of mobile students tend to enter the labour market of the region where they completed their university studies (AlmaLaurea, 2021). As a result, the inflow of highly skilled and educated individuals is expected to bolster the economies of northern provinces while weakening those of the southern provinces, thereby

exacerbating the longstanding territorial inequalities in Italy. This phenomenon introduces an endogeneity issue in our empirical analysis, as less developed regions in the Mezzogiorno lose high-quality students to the wealthier northern areas. We carefully address the different sources of endogeneity in section 4.1, in particular those relating to simultaneity and omitted variables bias. Ultimately, we estimate how and to what extent this mobility pattern contributes to diverging economic outcomes by enhancing GDP per capita growth in the North (a virtuous 'brain gain' cycle) while reducing it in the South (a detrimental 'brain drain' cycle).

3. DATA AND VARIABLES

This section presents the main variables used in the analysis of the effects of student mobility on territorial inequalities combining data on income growth at the NUTS-3 level with the information on student mobility choices between first- and second-level degrees. The variables definition and their sources are reported in Table A1 in Appendix A in the supplemental data online.

3.1. Student mobility

The data on student mobility choices have been extracted from the administrative database MOBYSU.IT, which includes individual data on the population of students enrolled in Italian universities. MOBYSU.IT allows us to follow students throughout their careers from enrolment to graduation and to trace all the changes regarding the chosen universities and degree programmes. This information allows us to measure student mobility flows by exploiting the data on universities' and degree programmes' locations. We focus our analysis on second-level mobility, given by the choices of students who have graduated from a first-level degree and decided to enrol in a second-level degree.[4] Importantly, focusing on second-level mobility, we can use the information on students' choices in the last step of their careers before entering the job market. Indeed, students who decide to migrate to pursue their academic career do not usually return to their origin area after graduation and are more likely to stay in the area where they obtain their graduation (AlmaLaurea, 2022; Oggenfuss & Wolter, 2019). This strategy allows us to identify how universities can impact territorial growth by attracting graduate students from other parts of the country.

Accordingly, starting from the population of students enrolled for the first time in an Italian university between the academic years 2010 and 2019, we apply a set of eligibility criteria to identify the population of interest. Specifically, we observe 3,035,179 students enrolled for the first time in a first-level degree in the Italian higher education system. From this population, we identify the graduated students by keeping the information on 1,147,636 students who have obtained the first-level degree in the time frame considered. Since we are interested in the impact of student mobility flows between first- and second-level degrees, we drop the information regarding graduates who have not enrolled in any second-level programme (596,771). Moreover, we drop students enrolled in an online degree programme (27,585) since these students do not have to migrate to attend their degree programmes. Therefore, the final data include 523,280 students who have obtained a first-level degree and have decided to enrol in a second-level degree within the Italian higher education system between 2013 and 2019.[5]

In the next step, we identify the 'mobile' students. To this aim, we define a matrix where each cell contains, for each academic year, the number of students who graduated in the origin province who have decided to enrol in a second-level programme in the destination province. To eliminate commuter students, we keep only those students who have chosen a university located in a province different from the origin one and have travelled more than 90 min to reach the destination university.[6] This choice avoids considering 'mobile' students those who enrol in a second-level programme in a different province but can easily continue to reside in their origin area and daily commute to the university location.[7] From this matrix, we obtain, for each province i, two main variables of interest. The first measures the number of students that migrate into the province i from other provinces of the country in year t ($stud\_in_{i,t}$). The second measures the number of students who decided to migrate outside the province i in year t ($stud\_out_{i,t}$). Moreover, to control for the number of students in the provinces, we keep the information on the number of graduates that stay in the origin province after graduation. This strategy allows us to also control in the robustness checks of the econometric analysis for the mobility choices of students during their first-level degree (Table 4). Indeed, according to our definition, 18.3% of observed students were mobile during their first-level degree and, among them, 23.1% decided to move to another province also during the master's degree.

Figure 1 presents two maps including the average distribution of enrolled students (Figure 1a) and the average ratio between incoming students and enrolled students (Figure 1b) at the NUTS-3 level. Figure 1a indicates that students are not only concentrated in big cities such as Milan, Turin, Rome and Naples, but also in smaller centres that benefit from the presence of prominent universities such as Parma, Bari, Pisa and Padua. Figure 1b shows that provinces with ratios of incoming to enrolled students above the median are primarily located in the Centre and North of the country, whereas most provinces in the South register a lower proportion of incoming students.

As we can see from Figure 1, among the 107 Italian provinces, 17 do not host any university degree programmes during the time considered. These provinces are distributed across the country without any clear geographical pattern. Moreover, students residing in these provinces at the time of enrolment represent only 4.8% of all observed students. In line with the findings on intrastate migration in the United States by Winters (2011), the majority of these students (54.2%) remain within their region of residence during their master's studies.

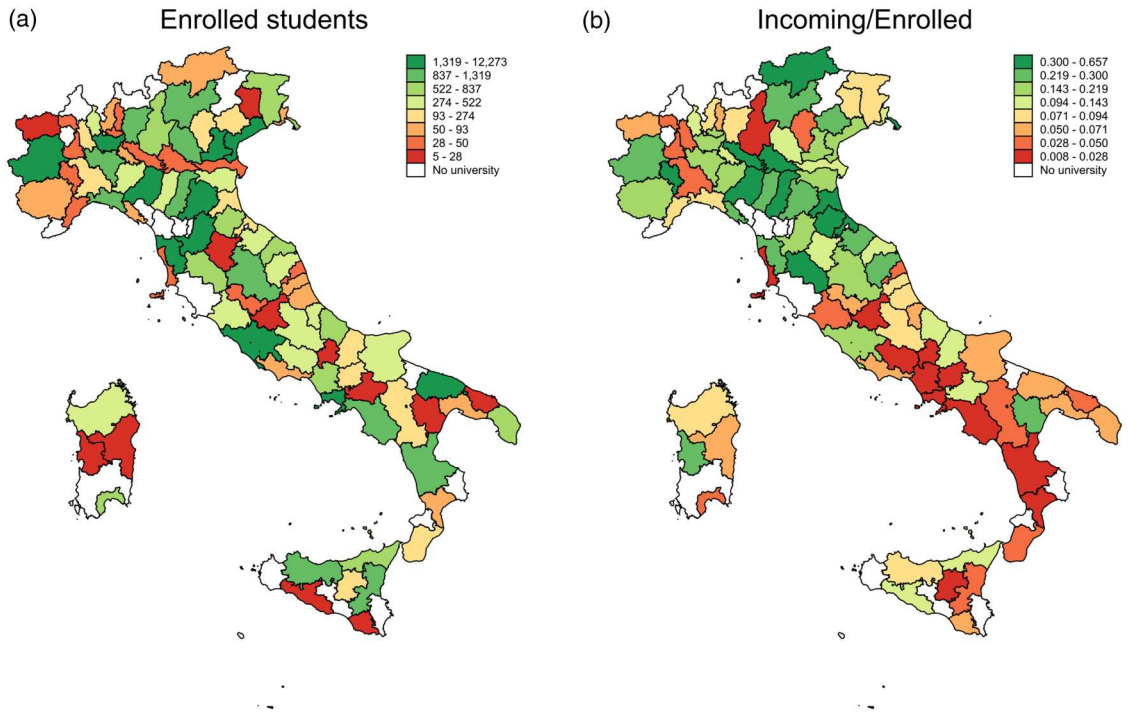

Figure 1. Enrolled and incoming students: (a) the NUTS-3 distribution of the average number of students enrolled for each province, 2013–19; and (b) the ratio between the average number of incoming students and average number of enrolled students, 2013–19.
Note: Yellows and reds indicate values below the observed median, while greens indicate values above the median. Regions without universities are shown in white.

Figure 2 shows the dynamic of our variables of interest, aggregated at the NUTS-1 level. Figure 2a shows the total number of student inflows. Tertiary students prefer universities located in the Centre–North to complete their postgraduate studies. Figure 2a shows a marked and increasing gap between the Centre–North (i.e., the

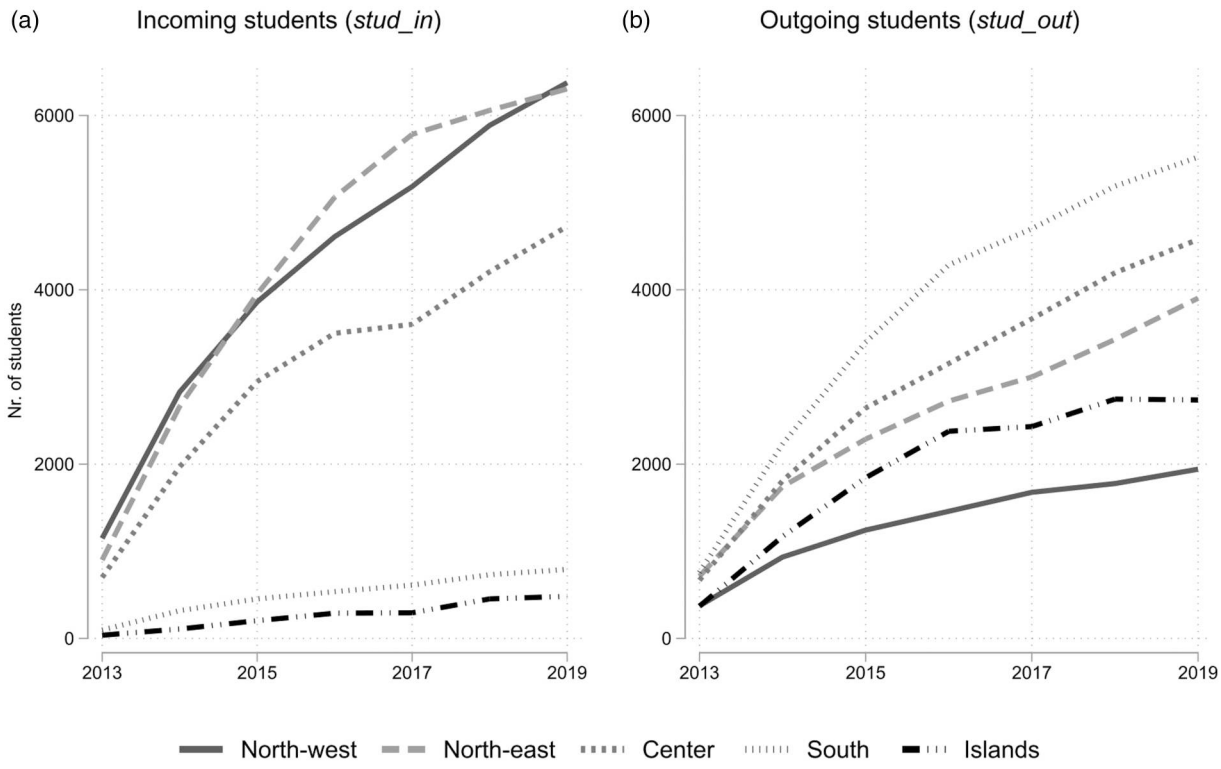

Figure 2. Tertiary student mobility, macro-regions (NUTS-1), showing the number of (a) incoming and (b) outgoing students by region (North-west, North-east, Centre, South, and Islands), 2013–19.
Note: Each region is represented by a different line style.

Centre, North-east and North-west) and the South (including the two big islands, namely Sicily and Sardinia). Figure 2b shows a quite different picture in terms of the outflows of students. The South is the main sending region, followed by the Centre and North-east. An important trend that emerges from the student outflow graph is that student mobility is also increasing in the northern regions. However, while southern students move to the Centre–North, northern students move to a different province but stay in the Centre–North. This spatial asymmetry has a clear impact on net flows (Figure 3). The North has a positive and growing gain of tertiary students. On the contrary, the South is losing tertiary students, and the net loss worsens over time. Outflows and inflows of students compensate with each other in the Centre. Overall, Figure 3 provides evidence of a noticeable brain drain from the southern regions to the Centre–North. What is more, the brain drain is increasing over time. For these reasons, in the econometric analysis, we will also investigate if and to what extent the inflow and the outflow of students impact the two macro-areas of the country differently.

3.2. Student mobility and income growth

We define our dependent variable as the growth rate of the GDP per capita in the province. As explained, the growth rate is computed over a three-year period to capture the comprehensive effects of students' presence in the hosting regions, as previously discussed in section 2.

To provide some suggestive evidence on the relationship between student mobility choices and income growth, Figure 4 includes two maps that show the average student migration balance (Figure 4a) and the average annual income growth rate (Figure 4b) at the NUTS-3 level. Student migration balance is given by the ratio between the average number of incoming and outgoing students. Therefore, a value > 1 indicates provinces that, on average, have experienced a net influx of students over time. To ease the interpretation of the map, the provinces with a migration balance < 1 are shown in yellow and red, while values > 1 are reported in greens.

The data on student migration balance show an asymmetric situation where most of the provinces that experienced a net influx of students are located in the North, while southern provinces are characterised by a net loss of graduates over time. Instead, the Centre is characterised by a more heterogeneous picture with the provinces of Rome, Florence and Pisa, which experienced a positive influx of students and are characterised by the presence of very important universities. The inflows–outflow balance is especially severe in the province of Isernia (which is not far from the big universities in Rome) and in the regions of Campania and Calabria. If we compare the distribution of student migration balance with the one regarding GDP per capita growth, we can notice a positive correlation: most northern regions are both attractive for mobile students and experienced higher values of GDP growth, while the opposite is true for provinces in the South and Centre, especially considering the Islands. However, we can observe many exceptions to this general pattern, especially considering the provinces in the south-east of the country and the province of Oristanoin Sardinia where, despite the net loss of students, we register an average growth in GPD per capita that is greater than the median value.

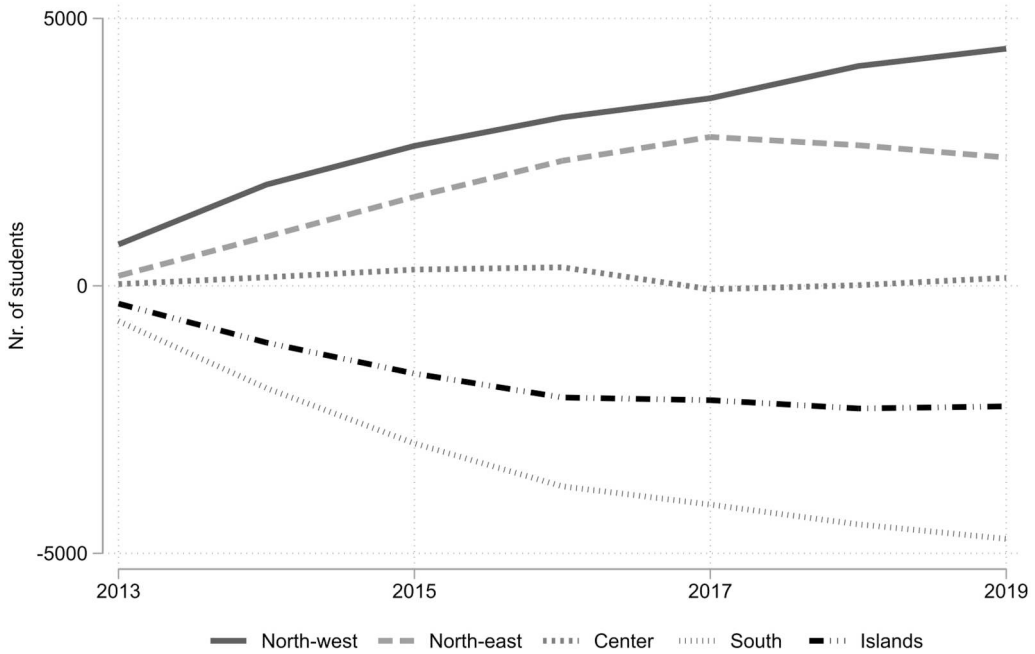

Figure 3. Net flows of tertiary student mobility, macro-regions (NUTS-1) in five Italian regions (North-west, North-east, Centre, South and Islands), 2013–19.
Note: Some regions show an increase in students, while others show a decrease. Each region is represented by a different line style.

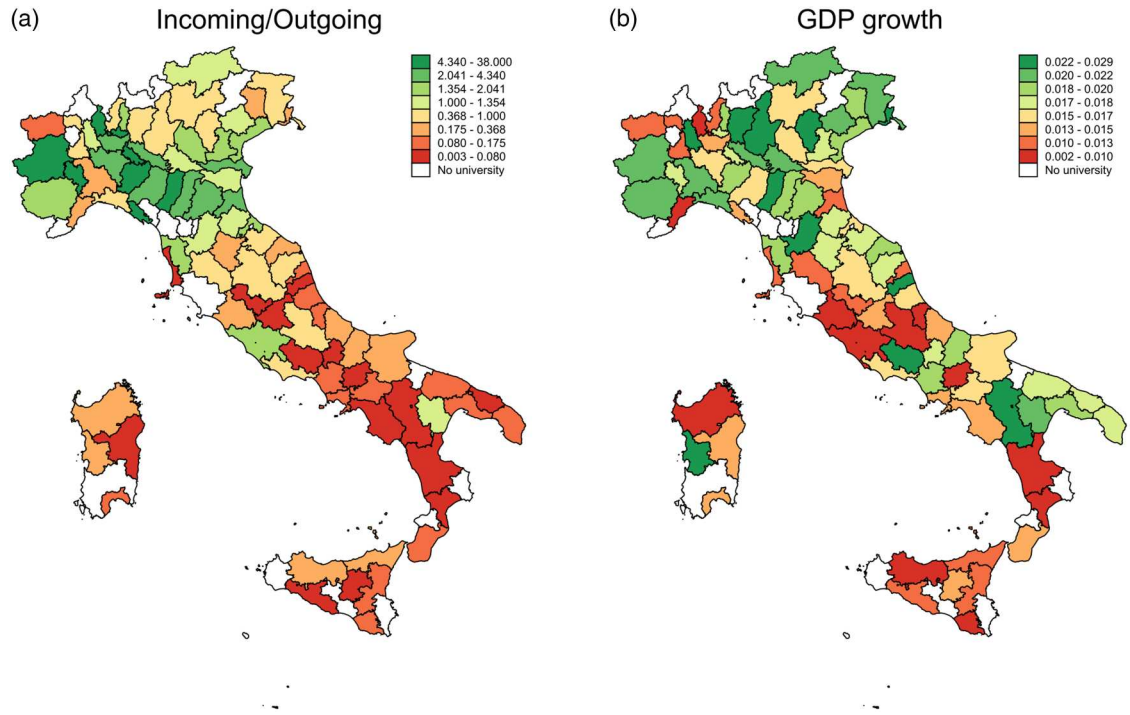

Figure 4. Students migration balance and gross domestic product (GDP) growth, 2013–19: (a) the NUTS-3 distribution of the ratio between the average number of incoming students and the average number of outgoing students observed for each province; and (b) the average annual growth rate of GDP per capita.
Note: (a) Yellows and reds indicate values < 1 (negative balances), while greens indicate values > 1 (positive balances); and (b) yellows and reds indicate values below the observed median, while greens indicate values above the median.

4. EMPIRICAL ANALYSIS

4.1. Econometric model

Our empirical model relies on the standard cross-regions (conditional) convergence equation of Barro and Sala-i-Martin (2003), as follows:

$$\log\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha \log(y_{i,t-1}) + \beta_1 \log(stud\_in_{i,t-1}) + \beta_2 \log(stud\_out_{i,t-1}) + \gamma X'_{i,t-1} + \delta_t + \theta_i + \mu_{j,t} + \epsilon_{i,t} \quad (1)$$

where the dependent variable is the growth rate of GDP per capita of province i in year t, and all the regressors are measured at the initial period. As we are interested in capturing all the possible channels through which mobile students might affect the income growth of the hosting region (see section 2), we consider a period of three years to compute our dependent variable.[8] As in Barro (2015), we average across annual growth rates of GDP per capita of each period, computing a three-year moving average.[9] The identification strategy assumes that our variables of interest (i.e., *stud_in* and *stud_out*) affect the GDP growth starting from the year of students' arrival/departure. This implies that both the migration decision and the destination choice are made beforehand, thereby excluding the possibility that our regressors are determined simultaneously with the dependent variable. Nevertheless, reverse causality could still be a concern if universities are concentrated in provinces with better economic performance and there is persistence in the (provincial) GDP growth rates. As for the former, it is worth pointing out that the geographical distribution of universities in Italy is only weakly related to local development, partly due to policy measures taken in recent decades aimed at establishing universities in less advantaged areas (Ballarino et al., 2019, 2022). Still, several attractive universities are located in developed provinces such as Milan, Rome and Bologna.[10] Therefore, although the model specified in equation (1) considers differences in economic development ($y_{i,t-1}$), we acknowledge the potential issue of reverse causality due to persistence in GDP growth rates. However, the descriptive statistics for GDP growth rates (Table 1) show that the within- and between-province standard deviations are of comparable magnitude, which significantly diminishes the risk of persistence at the NUTS-3 level.[11] Relatively high values of the within-province standard deviation emerge also for our variables of interest, pointing to substantial variability of students' flows across years.

We observed 90 provinces over the period 2013–19, where $t_1 = 2016$ and the corresponding initial period is $t_0 = 2013$, ending up with a panel of $n = 90$ and $T = 4$. Accordingly, $y_{i,t-1}$ indicates the initial level of GDP per capita. We expect α to have a negative sign due to diminishing returns, as predicted by neoclassical models. The effect of our variables of interest, namely the number of incoming students (*stud_in*) and the number of outgoing students (*stud_out*), are measured by β_1 and β_2, respectively. We then add a vector of time-varying controls at

Table 1. Descriptive statistics.

		Mean	SD	Minimum	Maximum	$N/n/\bar{T}$
GDP pc growth	Overall	0.06	0.03	−0.03	0.16	360.00
	Between	.	0.02	0.02	0.09	90.00
	Within	.	0.02	−0.01	0.14	4.00
GDP pc	Overall	26,506	7287	14,500	55,800	630
	Between	.	7224	14,957	52,957	90
	Within	.	1188	23,249	31,835	7
Incoming students	Overall	143	376	0	2963	609
	Between	.	342	0	1951	90
	Within	.	148	−1193	1155	7
Outgoing students	Overall	139	202	0	1174	624
	Between	.	178	0	853	90
	Within	.	95	−474	522	7
Resident students	Overall	714	1576	0.00	12,858	609
	Between	.	1492	3	10,321	90
	Within	.	469	−4147	3298	7
Population density	Overall	285	405	27	2652	630
	Between	.	406	34	2625	90
	Within	.	17	145	473	7

the NUTS-3 level (X'), such as population density and the number of resident students. The latter controls for possible shocks caused by the opening and closing of universities across provinces during the sample period. We include year dummies (δ_t) to control for effects stemming from nationwide economic policies, technological advancements or macro-economic shocks. Since many factors that affect the provincial growth rates are time-invariant (e.g., geographical characteristics, historical infrastructure, socio-cultural factors or longstanding institutional disparities), we include a rich set of fixed effects to reduce the omitted variable bias. More specifically, the NUTS-3 fixed effects θ_i account for time-invariant differences in productivity, technology and institutions across Italian provinces. Region-by-year fixed effects measured at the NUTS-2 level ($\mu_{j,t}$) control for factors such as regional government policies or investments in education and infrastructure, which affect both economic growth and student mobility across all provinces within region j during a given year.[12] Finally, $\epsilon_{i,t}$is the disturbance term. Table 1 illustrates some descriptive statistics of the variables. What emerges is a substantial within-group variation for the dependent variable as well as for the two variables of interest. Differently, both population density and the number of local students are characterised by a low within standard deviation.

4.2. Results for the baseline model

Equation (1) is estimated using the (within) fixed-effects estimator. The results of the full model are reported in Table 2, column 1. The estimated coefficient of the initial level of per capita GDP is negative and statistically significant, suggesting the presence of conditional convergence. Though the convergence rate appears high, it is worth remembering that this relatively high convergence speed is conditional to all the factors controlled by the inclusion of the (rich set of) fixed effects. As with regard to our variables of interest, the estimated effect of incoming students on the growth rate is positive and statistically significant. A 20% increase in the number of incoming students (i.e., the median value of our sample) raises the annual growth rate by 0.04%, on average at the NUTS-3 level. Differently, losing tertiary students does not affect the per capita GDP growth rate. The estimated coefficients for the two controls, namely population density and the number of resident students, are not statistically significant. These results are not surprising, given the inclusion of the fixed effects and that the two variables have a low within variation (Table 1). In the subsequent columns, we check the stability of the results by dropping alternatively one of the two variables of interest (columns 2 and 4) and the number of resident students (column 3). In column 2, the estimated impact of incoming students equals that found in the full model. In column 3, we drop the stock of local students obtaining the same results with respect to the other regressors. The specification in the last column includes only the outgoing students and population density, but the results remain unaffected. Overall, after controlling for different spatial and time fixed-effects, we find that incoming tertiary students have a positive effect on the growth rate of the Italian provinces. The results are robust to different specification of the variables of interest and to the inclusion of additional controls (see section 4.4).

4.3. Brain gain versus brain drain: an analysis by macro-area

As shown in section 3, interregional student mobility in Italy exhibits a distinct spatial pattern. Provinces in the

Table 2. Impact of student mobility on regional growth.

Dependent variable: GDP per capita growth	(1)	(2)	(3)	(4)
GDP per capita	−0.359***	−0.360***	−0.361***	−0.349***
	(0.029)	(0.027)	(0.027)	(0.027)
Incoming students	0.002**	0.002**	0.002**	
	(0.001)	(0.001)	(0.001)	
Outgoing students	−0.000			−0.000
	(0.001)			(0.001)
Population density	0.032	0.022	0.022	0.030
	(0.066)	(0.064)	(0.064)	(0.068)
Resident students	0.001	0.000		
	(0.002)	(0.002)		
N	283	292	292	283
R^2	0.713	0.714	0.715	0.708

Centre–North attract significantly more students than they lose, while the southern provinces experience the opposite. This disparity is not static; it is growing over time, further widening the gap between northern and southern regions. In this section, we investigate whether the asymmetry in the flow direction between the Centre–North and South also affects the impact of student mobility on the growth rate. Accordingly, we estimate a modified version of equation (1) where each variable of interest is alternatively interacted with a dummy variable, taking a value equal to 1 if the province is located in the South, and 0 if the province is located in the Centre–North. The results are reported in Table 3. As it emerges from column 1, the incoming students have a positive and statistically significant effect on the growth rate of provinces located in the Centre–North. The estimated impact is the same as that estimated in Table 2. On the contrary, the impact of incoming students on the growth rate of southern provinces is positive, but the linear combination of the sum of the estimated coefficients is very small and not statistically significant. Thus, the results in column 1 suggest that, on average, only provinces located in the Centre–North benefit from the positive effect of incoming students on the per capita GDP growth rate. Interestingly, when we analyse the difference in the impact of the number of outgoing students between the Centre–North and South, we find an opposite outcome (column 2). The linear combination test on the sum of the two coefficients, namely the outgoing students and the dummy variable, indicates a negative and statistically significant impact equal to 0.003. Therefore, a 24% rise in the number of outflow students (i.e., the median value of the growth rate of outgoing students in the southern provinces) decreases the annual growth rate of southern provinces by 0.07%. In summary, our results suggest that the Centre–North Italian provinces benefit from the influx of students, experiencing a positive brain gain. In contrast, the Southern regions suffer from a brain drain due to the loss of outgoing students, which exacerbates regional economic disparities.

4.4. Robustness

In this section we conduct three different sets of robustness analyses. We start by adding two variables aimed at controlling for different types of students based on their mobility status, and a variable measuring the impact of university's historical context. Next, we explore different

Table 3. Impact of student mobility on regional growth: differences between South and Centre–North.

Dependent variable: GDP per capita growth	(1)	(2)
GDP per capita	−0.337***	−0.344***
	(0.023)	(0.024)
Incoming students	0.002**	
	(0.001)	
South × Incoming students	−0.001*	
	(0.001)	
Outgoing students		−0.001
		(0.001)
South × Outgoing students		−0.002*
		(0.001)
Population density	−0.026	−0.022
	(0.061)	(0.066)
Resident students	0.001	0.002*
	(0.001)	(0.001)
Linear combination South	0.000	−0.003**
SE	(0.001)	(0.001)
Linear combination Centre–North	0.002**	−0.001
SE	(0.001)	(0.001)
N	294	285
R^2	0.677	0.678

Note: Robust standard errors clustered by region (NUTS-3) are shown in parentheses. Unbalanced panel with $n = 90$ and $T = 4$ (2013–19). The results are obtained using the within fixed effects estimator. All regressors are measured at the initial period ($t - 3$). All models include year fixed effects, NUTS-3 fixed effects and year by NUTS-2 fixed effect. ***Significant at 1%, **significant at 5%, *significant at 10%.

Table 4. Robustness: additional controls.

Dependent variable: GDP per capita growth	(1)	(2)	(3)
GDP per capita	−0.359***	−0.358***	−0.363***
	(0.029)	(0.028)	(0.028)
Incoming students	0.002**	0.002**	0.002**
	(0.001)	(0.001)	(0.001)
Outgoing students	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.001)
Population density	0.032	0.033	0.076
	(0.066)	(0.067)	(0.073)
Resident students	0.001	0.001	0.000
	(0.002)	(0.002)	(0.002)
Bachelor mobile students	0.000		
	(0.001)		
Bachelor only		−0.000	
		(0.003)	
University age			0.003
			(0.002)
N	283	283	283
R^2	0.712	0.712	0.719

measures of our variables of interest. Finally, we focus exclusively on students enrolled in science, technology, engineering and mathematics (STEM) disciplines.

Table 4 presents the estimates of the baseline model in Table 2, equation (1), with additional controls. In column (1), we include the number of students who moved to province *i* for their bachelor's degree and remained in the same province *i* for their master's degree ('Bachelor mobile stud.').[13] The estimated impact is negligible and not statistically significant. In column (2), we add the number of students who earned a bachelor's degree in the initial period but did not enrol in any master's degree programme ('Bachelor only').[14] Their impact is nearly nil and not statistically significant. Lastly, in column (3), we consider the historical background effects of universities, as institutions integrated into local economic structures may ease students' transitions into the labour market. To capture this effect, we include the average age of universities located in province *i* ('University age'). While the estimated effect is substantial in size, it is statistically significant only at the 15% level. It is worth pointing out that the results for our variables of interest remained unaffected by the inclusion of the three different controls.

Different measures of our variables of interest are employed in the second set of the robustness analysis. First, we use the ratio of both incoming and outgoing students on the total number of local students to control for the size of the university student population. The results reported in Table 5, columns (1) to (3), are not statistically different from the main results reported in Table 2. Second, we measure our main regressors as a ratio of incoming (outgoing) students in the local population. Again, the results reported in the last three columns of Table 5 are similar to the ones obtained by measuring the variables in levels.

The final robustness check aims to determine whether the baseline results discussed in Table 2 are affected by the different types of second-level degrees in which mobile students are enrolled. The literature has investigated the differentiated impact on economic performance stemming from graduates in STEM compared with non-STEM disciplines (see Murphy et al., 1991, for an early contribution;

Table 5. Robustness: alternative measures for the variables of interest.

Dependent variable: GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita	−0.361***	−0.361***	−0.349***	−0.359***	−0.360***	−0.347***
	(0.028)	(0.027)	(0.027)	(0.029)	(0.027)	(0.028)
Incoming students/local students	0.001*	0.001**				
	(0.001)	(0.001)				
Outgoing students/local students	−0.001		−0.001			
	(0.001)		(0.001)			
Incoming students/population				0.002**	0.002**	
				(0.001)	(0.001)	
Outgoing students/population				−0.000		−0.000
				(0.001)		(0.001)
Population density	0.037	0.024	0.030	0.033	0.023	0.026
	(0.068)	(0.066)	(0.067)	(0.066)	(0.064)	(0.068)
Resident students				0.001	0.000	0.001
				(0.002)	(0.002)	(0.002)
N	283	292	283	283	292	283
R^2	0.713	0.713	0.709	0.713	0.714	0.708

and Kitagawa et al., 2022, for a more recent study). The idea is that what really matters for economic growth is not only the level of human capital stock (usually measured by the number of graduates) but also the type of knowledge embodied in this human capital. Graduates from STEM fields are equipped with innovation-enhancing skills that are increasingly valuable in a knowledge-based economy. Therefore, we aim to test whether students in STEM programmes have a stronger impact on local economic performance. To this end, we re-estimated the model, focusing solely on STEM mobile students, who on average account for 30% of the total mobile students in our sample. As shown in Table 6, the impact of STEM students is not statistically different from that of the overall mobile student population. Further research is needed on this issue, as the effect of STEM mobile students on local development may require a longer time lag to become effective, potentially through an increase in entrepreneurial activities (Colombo & Piva, 2020). Moreover, as suggested by Kitagawa et al. (2022), the effect of STEM students on the local economy may vary between urban and non-urban contexts. On the other hand, it should also be noted that students enrolled in scientific programmes were found to be less mobile than those enrolled in other fields, such as humanities and social sciences, not only for Italy (Columbu et al., 2021a), but also for other countries (Haussen & Uebelmesser, 2018).

Table 6. Robustness: only science, technology, engineering, and mathematics (STEM) mobile students.

Dependent variable: GDP per capita growth	(1)	(2)	(3)
GDP per capita	−0.401***	−0.377***	−0.338***
	(0.043)	(0.029)	(0.025)
Incoming students STEM	0.001**	0.001**	
	(0.001)	(0.001)	
South × Incoming students STEM		−0.001	
		(0.001)	
Outgoing students STEM	−0.001		−0.000
	(0.001)		(0.001)
South × Outgoing students STEM			−0.002*
			(0.001)
Resident students	0.001	0.000	0.001
	(0.003)	(0.002)	(0.001)
Population density	0.256*	−0.023	−0.025
	(0.152)	(0.085)	(0.062)
Linear combination South (STEM-IN)		0.001	
SE		(0.001)	
Linear combination Centre–North (STEM-IN)		0.001	
SE		(0.001)	
Linear combination South (STEM-OUT)			−0.000
SE			(0.001)
Linear combination Centre–North (STEM-OUT)			−0.000
SE			(0.001)
N	193	205	283
R^2	0.664	0.594	0.645

5. AN EXTENSION: THE IMPACT OF STUDENT MOBILITY ON INCOME INEQUALITIES BETWEEN THE SOUTH AND THE CENTRE–NORTH

The previous section shows the impact of student mobility flows on the regional income growth in Italy. Building on this result, this section extends our investigation by examining the relationship between student mobility and regional income inequalities. This empirical exercise helps to measure how students contribute to the levels of income in regions and how this effect differs when considering southern or northern areas of the country. To this end, we estimate the following econometric model:

$$\log(y_{i,t}) = \beta_0 + \beta_1 \log(stud\_in_{i,t-1}) + \beta_2 \log(stud\_out_{i,t-1}) + \gamma X'_{i,t-1} + \delta_t + \theta_i + \mu_{j,t} + \epsilon_{i,t} \quad (2)$$

where the response variable now is the log of GDP per capita. The right-hand side of equation (2) is the same as the one in equation (1) with the exclusion of the initial level of GDP per capita. Column 1 of Table 7 shows the results without the interaction term. A 20% increase in the number of incoming students raises the per capita GDP by 0.08%. On the contrary, the estimated coefficient of the outgoing students is very small and not statistically significant. In column 2, we interact the incoming students variable with the dummy South to investigate whether the impact of incoming students on GDP per capita differs between provinces in the South and those in the Centre–North. The linear combination test reveals a negligible and not statistically significant impact of incoming students on the GDP per capita of southern provinces. Conversely, for central–northern provinces, a 22% increase in the number of incoming students (i.e., the median growth rate of incoming students in these provinces) raises the GDP per capita by 0.18%. The results in column 3 indicate that a 24% rise in the number of outflow students (i.e., the median value of the growth rate of outgoing students in the southern provinces) decreases the GDP per capita by 0.22%. Interestingly, the latter value is very close to the effect estimated by Binassi et al. (2021) for the South using a different methodology, over the period 2007–18. Regarding the effect of outgoing students on the GDP per capita of provinces located in the Centre–

Table 7. Impact of student mobility on regional gross domestic product (GDP) per capita level.

Dependent variable: GDP per capita level	(1)	(2)	(3)
Incoming students	0.004*	0.008***	
	(0.002)	(0.002)	
Outgoing students	0.000		−0.000
	(0.003)		(0.003)
Population density	0.012***	0.009**	0.007
	(0.001)	(0.004)	(0.005)
Resident students	−0.003	−0.002	0.002
	(0.005)	(0.005)	(0.004)
South × Incoming students		−0.007**	
		(0.003)	
South × Outgoing students			−0.009***
			(0.003)
Linear combination South		0.000	−0.009***
SE		(0.003)	(0.003)
Linear combination Centre–North		0.008***	(0.003)
SE		(0.002)	(0.003)
N	451	463	505
R^2	0.898	0.997	0.997

North, the estimated coefficient is very small, and it is not statistically significant.

Overall, this empirical exercise confirms our previous findings and further indicates that the internal mobility of tertiary students exacerbates the income inequality between the South and the Centre–North. To give a better interpretation of this result, we use the estimated effects and the observed annual growth rates of incoming students (for the Centre–North) and outgoing students (for the South) to compute the additional contribution of students' mobility to the dynamics of GDP per capita inequality between these two macro-areas during our time frame.[15] The results are shown in Figure 5. At the end of our sample period, the mobility of tertiary students contributed to enlarging the GDP per capita gap between the South and the Centre–North by 1.3 thousand euros.

6. DISCUSSION AND CONCLUSIONS

Universities draw an extensive influx of talented students from various regions and countries who are attracted by the quality of teaching, research, and services and the opportunities offered by the local labour market. This influx, in turn, fuels the advancement of their host communities by influencing spending patterns and employment opportunities and fostering entrepreneurial activities and the dissemination of knowledge.

The study delves into student mobility in Italy and its impact on local economic performance, analysing 90 NUTS-3 provinces from 2013 to 2019. We focus on the

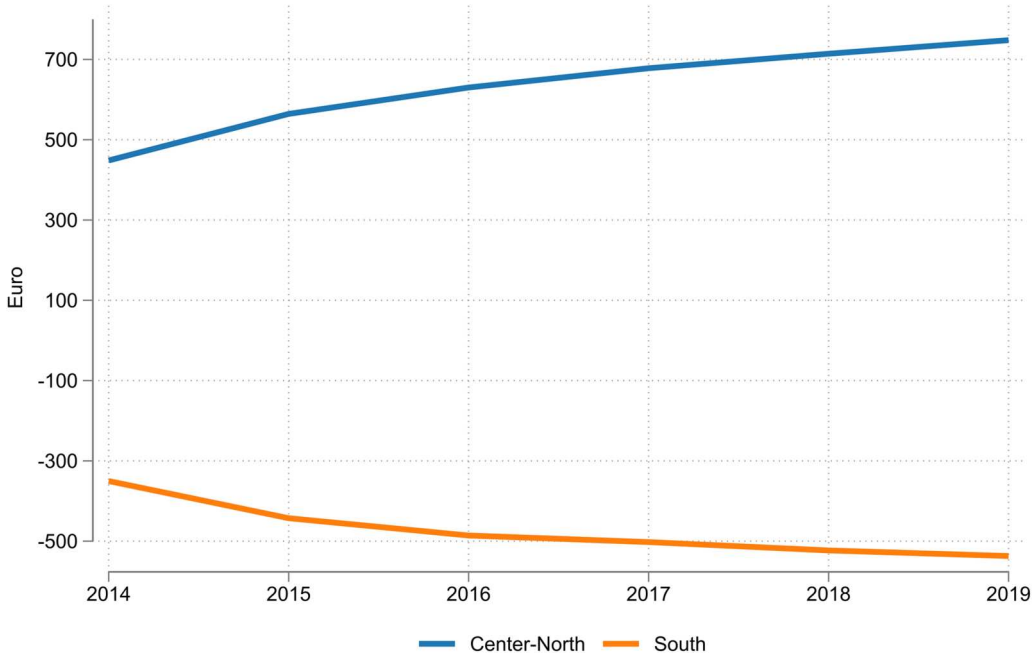

Figure 5. Impact of tertiary student mobility on gross domestic product (GDP) per capita inequality between the South and the Centre–North (€).
Note: Shown is the additional contribution of student mobility to the dynamics of GDP per capita gap between the two macro-areas. Values are derived from estimated effects and observed annual growth rates of incoming students in the Centre–North and outgoing students in the South.

mobility flow of students who have obtained a first-level degree and have decided to enrol in a second-level course in a different Italian province. Focusing on students transitioning from first to second-level degrees adds a hint to understanding the dynamics of talent migration and local economic regional development. Italy's student mobility exhibits a distinct spatial pattern, with a significant influx of students from the South to central and northern regions, intensifying over time. Between 2013 and 2019, on average, 24.7% of first-level graduates in southern universities decided to enrol in a master's degree programme provided in a central or northern region, while only 0.6% of graduates followed the opposite migration pattern.

The study employs a fixed-effects panel growth model to analyse the relationship between students' mobility and economic growth in Italian provinces. We use provincial-level data and a rich set of fixed effects to mitigate endogeneity due to reverse causality and omitted variables. Looking at the whole Italy, the first result underlines that incoming tertiary students positively impact the local growth rate, with a 20% increase in mobile students raising the GDP growth by 0.04%, while the loss of tertiary students does not affect the economic growth of the origin province. The results also indicate a negative and statistically significant coefficient for the initial level of per capita GDP, suggesting conditional convergence. Population density and resident student numbers show no significant impact. Robustness checks, introducing new control variables and different measures of our interest variables, confirm these findings.

Further analysis divides provinces into Centre–North and South regions, revealing a clear spatial disparity in student flows. Provinces in the Centre–North benefit more from incoming students, while the impact is not significant in the South. Conversely, outgoing students negatively affect the economic growth rate in the South, but they do not significantly impact the performance of the Centre–North provinces. Together, these two effects worsen the regional disparities in Italy. Thus, the graduate flow phenomenon strengthens the economy of the Northern provinces (brain gain) while simultaneously depleting the opportunities in the Southern ones (brain drain), exacerbating the enduring spatial inequalities within Italy.

This brain gain vs brain drain spatial pattern generates a self-reinforcing virtuous circle in the northern regions and a vicious circle in the southern provinces. In the North, the influx of talented students positively impacts the local economy and its innovative and entrepreneurial activities, giving rise to higher economic growth and employment opportunities and, therefore, attracting more mobile students. In contrast, the southern regions lost a significant part of their most capable graduates, thus further impoverishing the local social and economic structure.

Based on these empirical insights, a range of policy interventions may be proposed to address the spatial disparities observed among Italian regions stemming from student mobility. First, direct targeted investments towards enhancing southern areas' education infrastructure, research facilities, and faculty development. Such initiatives aim to augment the educational landscape, improving the quality of academic offerings and support services. This enhancement seeks to oppose the brain drain phenomenon by fostering an environment conducive to retaining and attracting talented students. Similarly, public authorities, particularly in the Mezzogiorno regions, should implement communication and promotion campaigns targeting potential students. At the same time, financial aid programmes must be established to fully support individuals who, due to economic or social barriers, are unable to access higher education, as well as those who drop out after their first year of study. Our findings suggest that effective policy interventions aimed at increasing the number of university students and graduates could have a significant economic impact, particularly in the southern regions. Moreover, tailored programmes and incentives could be devised to incentivise graduates from southern universities to return to their native regions after completing their studies. These initiatives might encompass a spectrum of support mechanisms, including financial incentives, vocational guidance, and avenues for professional development and career progression. Policy measures are also required to nurture entrepreneurship and foster innovation within southern regions by providing incentives and resources to promote nascent enterprises and facilitate their growth.

At a broader level, it becomes imperative for public authorities – operating at European, national, and regional levels – to devise and execute holistic regional economic development strategies accustomed to the distinctive necessities and impediments of the southern regions. By implementing these policy measures, Italy can work towards reducing the spatial disparities caused by student mobility, thereby promoting inclusive growth and fostering sustainable development across regions.

DATA AVAILABILITY STATEMENT

The data used in this study were processed in accordance with the research protocol for the study 'From High School to the Job Placement: Analysis of University Careers and University Mobility from Southern to Northern Italy' in the Ministry of University and Research, the Ministry of Education and Merit, the University of Palermo as the lead institution, and the INVALSI Institute. The reference researcher is Mariano Porcu. Due to institutional agreements and privacy regulations, the data are not publicly available outside of this research framework.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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NOTES

1. For the USTAT open data portal on Italian higher education system, see https://dati-ustat.mur.gov.it/dataset/immatricolati/resource/fa028588-c0a3-4dc3-a73f-915162ed99b4/.
2. The 'third mission' includes several activities such as know-how and technological transfer, regional leadership, knowledge network hubs, entrepreneurship development, and public engagement.
3. Building upon the Triple Helix concept, the Quadruple Helix (Carayannis & Campbell, 2009) expands the framework by incorporating civil society as the fourth key actor.
4. Italy has two kinds of first-level or bachelor's degree programmes: the *Laurea*, which is a three-year programme, and the *Laurea a ciclo unico*, which is a five- or six-year programme. Second-level or master's degree programme are two-year programmes called *Laurea Magistrale*. The relationship between the multi-cycle organisation of modern university systems and students mobility has been analysed by Mollica and Petrella (2017) and Gareis and Broekel (2022), among the others.
5. We start from 2013 to consider that students of the 2010 cohort need at least three years to complete their first-level degree and enrol in a second-level degree.
6. Travel distance is obtained from ISTAT and is defined as the minimum distance (min) by car between any pair of observed cities.
7. For example, the distance between the city of Pavia, Lombardy, and the city of Alessandria, Piedmont, is 45 min by car. We observe 4950 pairs of municipalities that host a degree programme and are located in different provinces. Among these pairs of municipalities, 869 are located at less than 90 min of distance.
8. Three years is roughly the average time for achieving the master's degree during the considered period (AlmaLaurea, 2021). Moreover, the impacts on investments, firm creation and labour markets manifest themselves with some delay.
9. We keep only those provinces with at least one university in one year during the analysed period.
10. As also pointed out by Faggian and McCann (2009), Italy features a multipolar system with various regions offering both competitive labour markets and appealing universities, unlike countries such as the UK, where London holds a dominant position.
11. Reverse causality may be severe at more aggregate levels, such as NUTS-2 and (especially) NUTS-1.
12. Including fixed effects in the regression may result in a possible overestimation of the convergence rate. However, the trade-off between the overestimation of the rate of convergence and the reduction of the omitted variable bias is not severe when the observed units are not heterogeneous (such as within-country regions) and the length of the period is not too long (see Barro, 2015; and Gennaioli et al., 2014, for a discussion).
13. On average, these students represent 12% of the total number of master's degree students in our sample.
14. Unfortunately, we lack further information about these graduates (since they are not included in the administrative database), meaning we cannot track their employment status or mobility choices.
15. The annual growth rate of incoming (outgoing) students for each macro-area is computed as a weighted average of the annual growth rates at the NUTS-2 level, using as weight the number of local students.

ORCID

Ivan Etzo http://orcid.org/0000-0001-9221-9891
Raffaele Paci http://orcid.org/0000-0003-0301-438X
Cristian Usala http://orcid.org/0000-0001-6524-0900

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