Universities' Responses to Crises: The Influence of Competition and Reputation on Tuition Fees

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Abstract

Modern societies regularly face crises that have major disruptive effects. Learning from past crises can inform better choices and policies when facing a new one. Following the 2008 global financial crisis, Higher Education scholars explored its effects on students' tuition fees through cuts in public funding. This article instead investigates how universities' decisions on tuition fees have been affected by other factors, beyond the decrease in public funds. As such, it explores the role of competition and reputation in affecting universities' decisions on tuition fees when facing a crisis. Using data from 59 public Italian universities in the period between 2003 and 2014, we found that universities increased tuition fee by an average of 27% per student in response to the crisis. At the same time, high competition mitigated the increase of tuition fees, except for the case of highly reputed universities, which charged even higher tuition. These findings highlight the importance of monitoring fees in times of crises, as well as the complex role of competition and reputation in containing or inflating university tuition fees.

Keywords: tuition fees, financial crisis, economic crisis, competition, reputation, quasi-market, Italy

JEL classification: I22, I28, H52, H75

Introduction

Over recent decades, the relative stability of modern societies has often been abruptly interrupted by major shocks, like the financial crises in 2001 and 2008, as well as the current pandemic. Such shocks can induce severe economic crises, the effects of which are often greater than the accumulation of small changes that occur in periods of stability (Taleb, 2007). Therefore, in recent years, scholars have paid growing attention to the effects of crises, including on Higher Education (HE); such research has, for example, shed light on some of the crucial effects of a crisis on tuition fees dynamic. Following the global financial crisis, studies from the U.S. (Gu, 2015; Serna, 2017), the U.K. (Wakeling & Jefferies, 2013; Wilkins, Shams, & Huisman, 2013), and several continental European systems (e.g. Moulin, Flacher, & Harari-Kermadec, 2016 for France; Teixeira, Rocha, Biscaia, & Cardoso, 2014 for Portugal; Pigini & Staffolani, 2016 for Italy), have focused, in particular, on the effect of the financial crisis through cuts in public funding. However, other relevant aspects remain unexplored.

In fact, universities vary in their characteristics and they are located in contexts with different features, which can affect their responses to a crisis. The goal of this article is to shed light on two main factors that have the potential to affect a university's decision on tuition fees in response to a crisis, namely the level of competition to which it is subjected and its reputation.

Competition in HE is strongly affected by geographic proximity. However, the effect of geographic proximity is complex; on the one hand, proximity increases competition and hence price reduction, while, on the other hand, it favours an agglomeration effect that attracts more students and enables universities to charge higher tuition fees (Cattaneo, Malighetti, Meoli, & Paleari, 2017; Sá, Florax, & Rietveld, 2004). We also investigated the role of universities' reputation, as prestigious universities may have the flexibility, or the necessity, to keep tuition fees high, since high fees are an effective signal of quality (Marginson, 2006).

The empirical analysis conducted in this paper explores the factors that affect variations in the tuition fees of 59 Italian public universities between 2003 and 2014. We found that the crisis results in an overall increase in tuition fees, and that high competition mitigated this increase after the crisis, except for the case of highly reputed universities, which tended to charge even higher tuition fees.

The remainder of the paper is organized as follows. Section 2 presents the main findings of the research on the effects of a crisis on tuition fees and explores the potential effects of competition and reputation. Section 3 describes the research design. Section 4 discusses the results of the empirical analysis, and Section 5 concludes.

The heterogeneous effect of economic crises on tuition fees

Given the fundamental importance of tuition fees on students' behaviour and choices, how university prices are set has been extensively studied since the seventies (Serna, 2017). The 2008 economic crisis turned scholarly attention to the effect of reduced public funding for HE, as this led to an increase in university tuition fees due to a substitution effect (Serna, 2017; Teixeira et al., 2014; Wilkins et al., 2013).

The decrease in public funding is not the only way in which an economic crisis can affect tuition fees. The downturn of the economy also affects income and unemployment rates, thus influencing both the probability of enrolling in university and families' willingness to pay for tertiary education (Long, 2014). Pigini & Staffolani (2016) showed that the enrolment rate of students coming from lower socio-economic backgrounds was reduced, as they are more sensitive to changes in university costs. Cattaneo, Horta, Malighetti, Meoli, & Paleari (2017) found that the financial crisis widened gender disparity in relation to university choices, thus placing female students at a disadvantage in the labour market and in society. A crisis also affects enrolment composition by increasing mobility (Cattaneo, Malighetti, et al., 2017), as students may become more selective and prone to moving further away in search of better opportunities.

Changes in students' enrolment choices may, in turn, affect universities' tuition fee behaviour. After the economic crisis, universities' competition for students was exacerbated by the decrease in the student population due to demographic changes and economic difficulties, and remaining attractive in the eye of students has become a priority in terms of universities' survival (EUA, 2016). The capability to attract students is strongly influenced by the presence and activities of neighbouring universities (Gu, 2012). Past studies have highlighted the role of spatial dynamics among competitors - especially neighbouring ones - in affecting university fees (Gu, 2015; McMillen, Singell, & Waddell, 2007). McMillen et al. (2007) showed that private U.S. universities increased their tuition fees when other private universities within a 400 mile radius did the same. Gu (2015) further enriched this research by demonstrating the actual and robust importance of spatial dimension in universities' price model, by relying on the top 100 ranked U.S. universities. He argued that the relationship between prices and the geographical distance of universities is an inverse U-shape, instead of an inverse linear relation. Namely, universities can set higher tuition fees when they have many neighbouring universities due to an *agglomeration effect* that increases attractiveness to students, or when they have very few neighbouring universities (as they enjoy a quasi-monopolistic position in this case).

An economic crisis may change the equilibrium between the forces affecting tuition fees. As previously mentioned, geographic proximity induces contrasting effects on the level of tuition fees due to agglomeration and competition. In normal conditions, high proximity relates to higher fees, suggesting that the agglomeration effect is stronger than the effect of competition. However, according to Canche (2014), a common strategy of both public and private Higher Education Institutions (HEIs) is to compete locally and remain a marketable option for students by decreasing their tuition fees. Hence, by increasing the need to remain attractive to students, it is possible that an economic crisis exacerbates competition to the point that it overcomes the agglomeration effect, leading high proximity to predict lower tuition fees (Cattaneo, Malighetti, et al., 2017; Sá et al., 2004).

A second important factor that has the potential to affect a university's decision on tuition fees in response to a crisis is its reputation. HE is a reputational market in that the image that universities portray, and the reputation they establish, has a lot of influence on the decision-making process of prospective students (Briggs & Wilson, 2007). According to this view, students who attend the highest quality and best regarded universities are the most distinguished ones for intrinsic characteristics (skills, talent) and/or extrinsic conditions (funding, encouragement from parents, social norms) (Zhang, 2005). According to signalling theory, students who graduate from a high-quality and a highly regarded university will benefit the most from their education both economically and socially, as the value of the degree is related to the perceived value of the credentials associated with the reputation of the university (Collins, 1971; Spence, 1973). The "race for credentials" assumes a greater importance in times of crisis, when the competition for jobs in the labour market is greater, making students search more intensively for high value credentials (Cattaneo, Horta, et al., 2017; Sojkin, Bartkowiak, & Skuza, 2015). In uncertain labour markets, attending prestigious universities is what matters in terms of improving students' chances of success after graduation, thus ensuring survivability (Marginson, 2016). Moreover, in relation to the recent financial crisis, prestigious universities have a competitive edge due to the relevance of positional goods (Sojkin et al., 2015), as students consider them to be more valuable and less risky options in the long run (Wright & Horta, 2018). Therefore, prestigious universities are expected to cope better with an environment that is becoming increasingly uncertain. As long as a university is considered to be of high quality, students will be willing to pay, even if it is more expensive. As a consequence, highly reputed universities are expected to keep tuition fees high as a way to symbolise their quality in times of crises (Marginson, 2006).

Methods and data

Sample and data

Our sample includes 59 public Italian universities[1] observed in the period between 2003 and 2014. We rely on the data provided by the Ministry of University and Research (Ministero dell'Istruzione, dell'Università e della Ricerca - MIUR)[2] regarding students, academic and technical staff, educational offerings, and the funding of each university over time, as well as on information provided by the National Office of Statistics (ISTAT) at the regional level (according to NUTS-2 classification).

The Italian HE system comprises only university-type institutions and 95% of students are enrolled at public universities. Similarly to other continental European systems, it is largely funded publicly, and steering occurs mainly via state laws and regulations (Donina, Meoli, & Paleari, 2015). The core funding mechanism of public Italian universities consists of a block grant assigned by the national government that is allocated according to a lump-sum budgeting model, the so-called *Fondo di Finanziamento Ordinario* (FFO), which covers around 57% of the overall budget. The amount of tuition fees charged to students is regulated by law and cannot exceed 20% of the single state-allocated FFO fund (Law 7, August 2012, no. 135, conversion into law with modifications of Decree-Law 6, July 2012, no. 95). Revenues from tuition fees have been growing since the mid-90s, when Italian universities were granted more autonomy and decision-making power in setting prices due to reforms loosely inspired by the New Public Management principles (Reale & Seeber, 2013). Tuition fees can vary by discipline and between bachelor or master's programs. Students who take longer to graduate than the nominal duration of their degree course may also pay higher fees (Law 7, August 2012, no. 135).

In recent years, the Italian HE system has undergone a comprehensive reform process (Donina, Seeber, & Paleari, 2017), which increased the level of competition in the distribution of resources.[3]

Variables

The dependent variable is the average annual tuition *fee per student*, defined by considering the total number of bachelor and master's students enrolled per university per year.[4] Values are adjusted for inflation with 2003 as the reference year. The key explanatory variables are the financial crisis, the level of competitive pressure for each university and the institutional reputation.

The *crisis* variable is binary, assuming a value of 0 in the period between 2003 and 2007, and 1 in the period between 2008 and 2014 in order to take into consideration the effect of the crisis from its outset (Long, 2014). Since 2008, the crisis increased the regional imbalances throughout Italy (Lagravinese, 2015) and had a negative effect on family household income, which decreased by 9% between 2008 and 2012. Furthermore, starting from 2008, employment has decreased by 10.4% in the manufacturing sector, 4.4% in the construction sector, and 2.8% in the service sector (Lagravinese, 2015). Concerning the HE sector, public funding for universities (adjusted for the inflation rate) dropped by 17% from 2008 to 2015, whereas the student population dropped by 16% over the period between 2008 and 2015 (EUA, 2016).

Competition is estimated through four different measures derived from the general spatial competition models. We describe them from the simplest to the most complex. The *number of universities* per region is a common measure of competition, namely, the "number of organizations in a specific market" (see Salop 1979). The *inverse of the distance* between universities belonging to the same region is the equivalent of the inverse distance between two organizations as a measure of non-monetary transportation costs (see Brekke, Siciliani, & Straume, 2010, 2011). The *competitors' proximity index (ComPI),* which finds theoretical support in spatial location theory (see Fotheringham, Nakaya, Yano, Openshaw, & Ishikawa, 2001; Hotelling, 1929), measures the specific market pressure of each university *i* compared to its other competitors, by adopting the sum of the distances, weighted by the number of students enrolled at each university (i.e. from one institution to all the others). According to Cattaneo, Malighetti, et al. (2017), this index accounts for a university's

geographical location, which plays a key role in students' destination selection, and therefore on tuition price setting. Although the sample does not include traditional private universities, they are considered in all three measure of competition, as public universities compete not only with each other, but also with their non-state counterpart.

Finally, we consider university competition depending on both geographical proximity and the similarity of the educational programs they offer (Seeber et al., 2012). For example, two proximate universities that offer very similar programs will be especially strong competitors. Hence, we refined the *competitors' proximity index* by weighing it according to the overlap in the educational profile that exists between universities (Cattaneo, Malighetti, et al., 2017).[5] A detailed explanation of the *competitors' proximity index* and the *competitors' proximity index with discipline overlapping* (*adjusted ComPI*) is reported in the Appendix.

A university's *reputation* is measured by its presence in the Academic Ranking of World Universities (ARWU), one of the first and most commonly used global ranking of universities, published by the Jiao Tong University Shanghai since 2003.[6] For each year in the period between 2003 and 2014, the variable equals 1 if the institution is listed in the ranking and 0 otherwise (Seeber, Cattaneo, Huisman, & Paleari, 2016). On average, one out of every three Italian universities is included in the international ARWU ranking. The variable is calculated year by year.

Additionally, we controlled for other factors that can potentially affect tuition fees. For example, *State funding per student* is a major determinant of tuition level (e.g. Wakeling & Jefferies, 2013). This variable is given by the average amount of public funding (FFO) per student that a university receives from the state each year. We used the real value adjusted for inflation, taking 2003 as the base year. The *size* of the university is measured by the total number of students enrolled in bachelor and master's degrees. Larger institutions raise more revenue from tuition fees as they enrol more students. *Students aid* is measured by the average amount of money per student that regional authorities provide to finance each region for each year (i.e., the right to study - diritto allo studio

in Italian). As an indicator of wealth in the context of where the university is located, we considered the gross domestic product per inhabitant of the NUTS-2 region, indicated by the variable *GDP per capita.*[7] Finally, to control for the attractiveness of universities from the perspective of mobile students in times of crisis, we introduced the *share of non-regional students* enrolled in each university as a control variable.

Descriptive statistics

The Italian HE system has seen a decrease in the student population, especially after the economic crisis (-13% between 2008 and 2015) (Figure 1).

[Figure 1 near here]

Similarly, the state lump sum allocation remained stable at around €6.5 billion until 2008 and then dropped to €5.5 billion. The decline of revenues has in part been counterbalanced by the increase of tuition fees over time. While in 2003 the total revenues from tuition fees at public Italian universities were around €1 billion, they reached €1.25 billion in 2015. The amount of tuition fees per student has increased as well. In real terms, the value grew from € 732 before the crisis (average 2003-2007) to €1,120 after the crisis (average 2008-2015) (+53%).

Table 1 exhibits the descriptive statistics for our sample over the entire period of analysis, and Table 2 displays the correlation matrix.

[Table 1 near here]

[Table 2 near here]

Econometric model and estimation strategy

We specify a model for the tuition level of university i at time period t with university-specific

effects as the following equation:

$$y_{i,t} = \alpha y_{i,t-1} + \beta x_{i,t} + \gamma w_i + u_{i,t} \qquad (1)$$

where $y_{i,t}$ is the average tuition fees per student in period t, $y_{i,t-1}$ is lagged tuition level, $x_{i,t}$ is the vector of time-varying regressors (explanatory variables), w_i is the vector of unobserved characteristics of universities that have a significant impact on tuition fee levels, and $u_{i,t}$ is a random error term. The lagged dependent variable as regressor y_{it-1} controls for the inertia in tuitions, while unobserved characteristics w_i are assumed to be constant for each university (rather than varying across universities).

A concern with dynamic models is the serial correlation in errors. The estimator subtracts the time invariant component of the error term, such that autocorrelation in the remaining idiosyncratic error would indicate potentially invalid instruments. We report the second-order test for serial correlation in differences (AR2) according to Arellano & Bond (1991), and the J test as in Hansen (1982), in order to test the exogeneity assumptions. Another potential issue concerns the number of instruments used in the GMM system, since the model may be weakened by using too many instruments (see Roodman, 2009). The difference-in-Sargan test is reported even if, due to the wide sample size, the number of both observations and groups prevail on the number of instruments (Roodman, 2009).[8]

Results

Table 3 summarizes the main estimation results of Equation (1).[9] The variable crisis, the variable competition and the interaction between crisis and competition are statistically significant across all the models. We focused on presenting our findings in terms of the most refined competition measure, namely the adjusted CompI and the model including all the interactions (model 8). Nonetheless, the qualitative results were the same.

The coefficient for the lagged dependent variable is positive and statistically significant, meaning that the level of tuition charged by a university increases every year on average. In line with results from previous studies, the coefficient for the state funding per student was found to be negative and statistically significant, suggesting a substitution phenomenon in which students' fees partially compensate for the decline in public funds. A decrease in state funding by 10% per student leads to an average increase in tuition fees by 1.6% per student.

The impact of the *crisis* variable is positive and statistically significant, predicting an average increase in tuition fees by around 30%, which means €390 in the six years after the crisis. Arguably, the shock generated by the decline of public funds has determined a fixed effect on all universities.

The effect of geographic proximity on tuition fees changed due to the crisis. Before the economic crisis, the effect of competition based on geographic proximity and similar educational offerings on tuition fees was positive and equal to 0.053. Namely, universities with close competitors charge higher tuition fees – arguably due the agglomeration effect. Everything else being equal, an increase in the adjusted competitors' proximity index by 1 standard deviation (SD) corresponds to 2% higher tuition fees per year. After the crisis, the effect of competitors' proximity remained positive, but was much smaller (coefficient: 0.053-0.038=0.015). In economic terms, the economic crisis reduced the agglomeration force by 9.2% in the six years after the crisis.

As far as the other variables included in the model are concerned, all those reporting significant coefficients had the predicted signs. Likewise, HEIs placed in rich areas exhibit higher student tuitions (6.3% higher on average), as families with higher incomes are willing to pay more to attend universities. Finally, universities that enrol a high proportion of students from different regions charge higher tuition fees (15.9% higher on average).

[Table 3 near here]

In addition to this, we explored the effect of institutional reputation using four different models (Table 4). In model 1, we tested the effect of reputation and the moderating effect of the reputation (Reputation*crisis), and in Model 2 the moderating effect of competition was also included (Adjusted CompI*crisis). These models revealed no effect of reputation on setting tuition prices. In order to deepen the effect of reputation, we split the sample between highly reputed (Model 3) and non-highly reputed universities (Model 4). Although the effects of the variable crisis were similar for both (+0.059 and +0.047, respectively), highly reputed universities were subjected to stronger competitive pressure (Adjusted CompI*crisis) and significantly increased tuition fees (+0.049), whereas less reputed ones decreased them (-0.072).

[Table 4 near here]

Robustness checks

Since the financial crisis is one of the main explanatory variables in addition to competition, we tested whether 2008 represented a real paradigm shift in terms of university tuitions, as this was the year when public funds started to decrease and the country's socio-economic conditions started worsening. To this end, the stability of the competition indices' coefficients was assessed by adapting the structural break test, as described in Cattaneo, Horta, Malighetti, Meoli, & Paleari (2019), to the competing destinations model. A Chow breakpoint test over a range of dates (from 2003 to 2014) was used to calculate the F-statistic. The most likely date for a breakpoint is one that produces the highest F-statistic. The test revealed that a structural break occurred in 2008, leading to the inclusion of a step dummy variable (coded 1) for the years after 2008 (i.e. the structural break). In Table 5, we report the coefficients of the interaction between competitors' centrality index and a set of step dummy variables for each year between 2005 and 2014.

[Table 5 near here]

We also performed an additional robustness test for crises by substituting the dummy variable crisis with the regional unemployment rate. Table 6 shows that the results are stable.

[Table 6 near here]

Finally, the last robustness check consisted of using a spatial dynamic panel data model to estimate the dynamics of price setting, as shown in Table 7.[10] After controlling for spatial dynamic correlations, the results were very similar.

[Table 7 near here]

Discussion and conclusion

This study examined the effect of the financial crisis on university price setting in the Italian public HE system between 2003 and 2014. The crisis was found to have an important effect, increasing tuition fees by an average of 27% from 2008 to 2014. In fact, crises impact many aspects of people's everyday lives, with major consequences on students' choices. For instance, a crisis may force people from less affluent parts of society to seek a job rather than to study, whereas people that can afford to wait for an economic recovery may be more likely to pursue their studies. In our analysis, by isolating the effect of cuts in public funding, we demonstrated that an exogenous shock represented by the dummy variable crisis had a relevant impact on setting tuition fees. When the unemployment rate was adopted as an indicator of the crisis, the result remained the same.

At the same time, the results show that the crisis subtly but significantly impacted the rules that normally determine the levels of tuition fees. Before the crisis, universities close to each other were able to keep prices high and still attract students because of the agglomeration effect. After the

crisis, universities with high competition proximity increased the tuition fees less in comparison– arguably because the crisis strengthened the effect of competition over the agglomeration effect.

One important implication of this result is that, under certain circumstances, competition contributes less to keeping tuition fees low. In fact, while Italian universities get most of their resources from public funding, it is enough that a small share of their revenues depends on competition, as this makes an HE quasi-market work similarly to a full-fledged market. Competition induces universities to maintain a lower level of tuition fees, with the aim of protecting themselves from either local or regional competition, and continue to attract students (Foskett, Roberts, & Maringe, 2006). According to the economic theory of price setting in a competitive environment, adding a competitor increases the price sensitivity of a provider by augmenting its substitutability in the choice set (Huber, Holbrook, & Kahn, 1986). In this regard, universities could lower prices to attract more students or to fend off the effects of their competitors' lower prices, which threaten their existing student body (Winston & Zimmerman, 2000). Competition may operate as a mechanism to control the level of student fees by affecting the behaviour and even the survival of neighbouring universities, as well as distant ones (Hoxby, 1997, 2000). Price controlling might prevent universities from becoming mostly privately funded, thus preserving the collective dimension of the good of education (Christopherson, Gertler, & Gray, 2014). Moreover, monitoring the level of tuition fees prevents student debt from rising to an unbearable level. Hence, special attention should be given to monitoring the tuition fees of universities with few competitors. These are institutions that are often located in peripheral areas, which may strongly depend on public subsidies and may enter a vicious cycle wherein they charge higher tuition in a period of crisis, thus exacerbating their lack of attractiveness to students.

The results also show that reputation affects universities' behaviour in setting tuition fees in contexts of high competition; in response to a crisis, highly reputed universities charge even higher

prices. Arguably, then, highly reputed universities are not forced to lower their prices in order to remain attractive to students, because high tuition is commonly interpreted by students as a signal of quality, and in times of crises this may become even more valuable (Marginson, 2006).

Despite the results, this study has some limitations. First, the analysis considers the average price level as given, and not a result of the equilibrium between supply and demand. This aspect ought to be properly investigated by considering economic specifications from price setting theory. Moreover, the measure of tuition fees employed in this work does not fully capture the net price faced by students, as we only considered the listed tuition fees without isolating the effect of student grants. Such research would be able to assess the differential impact on students' participation in higher education, while considering a variety of contextual variables.

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Figures and Tables

Figure 1. The student population in the period between 2003 and 2015. This figure represents the total number of students enrolled in public Italian universities from 2003 to 2015.

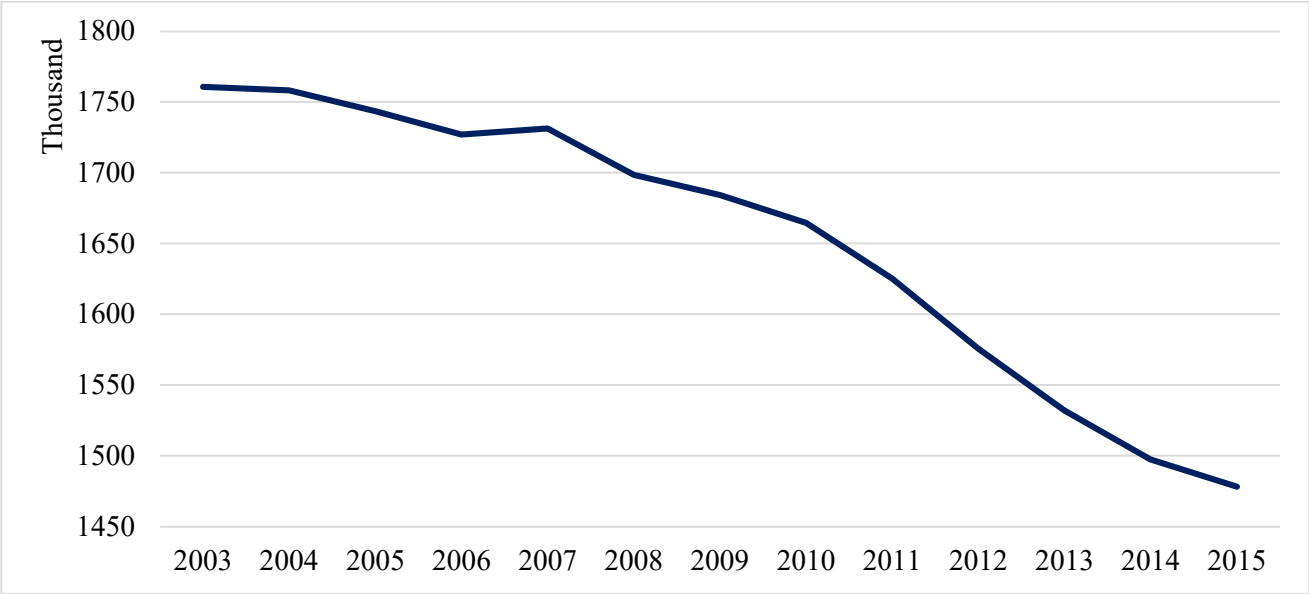

Table 1. Descriptive statistics. This table reports the descriptive statics for the 708 university-year observations employed for the empirical analysis. The sample consists of 59 public Italian universities observed in the period between 2003 and 2014.

	Obs.	Mean	SD	Min	Max
Fees per student (€)	708	946.01	590.29	269.98	6,708
State funding per student (€)	708	4,710	1,817	1,711	6,708
Student aids (€)	708	1,747	365	60	3,4674
Size (students)	708	28,204	23,941	1,318	150,010
Reputation (%)	708	33			
Universities per region	708	5.58	3.58	1	13
Inverse of distance	708	0.84	1.18	0.13	5.27
CompI	708	22,772	40,857	2,830	232,234
Adjusted CompI	708	9,206	20,200	74.24	15,1053
GDP per capita (€)	708	22,318	6,222	11,673	34,509
Share of non-regional students (%)	708	21%	15%	1%	62%

Table 2. Correlation matrix. * exhibits significant values ($p < 0.05$).

	1	2	3	4	5	6	7	8	9	10	11	12
1. Fees per student	1											
2. Crisis	0.309*	1										
3. State funding per student	0.071	0.235*	1									
4. Student aids	0.020	0.234*	0.037	1								
5. Size (students)	0.047	-0.043	-0.028	0.056	1							
6. Reputation (%)	0.203*	-0.034	0.146*	0.069	0.643*	1						
7. Universities per region	0.133*	0.000	0.003	0.234*	0.040	0.032	1					
8. Inverse of distance	0.087*	0.000	0.024	0.036	0.145*	0.099*	0.476*	1				
9. CompI	0.096*	-0.026	0.031	0.047	0.036	0.112*	0.505*	0.948*	1			
10. Adjusted CompI	-0.078*	-0.002	-0.014	0.133*	0.407*	0.179*	0.185*	0.502*	0.438*	1		
11. GDP per capita	0.537*	0.088*	0.156*	-0.006	0.109*	0.330*	0.235*	-0.000	0.080*	-0.092*	1	
12. Share of non-regional students	0.164*	0.183*	0.086*	0.125*	-0.157*	0.102*	-0.195*	-0.189*	-0.104*	-0.066	0.419*	1

Table 3. The GMM system estimates tuition fees per student on average. This table reports the results of dynamic panel regressions on the level of tuition fees per student charged by 59 public Italian universities in the period between 2003 and 2014. Model 1 includes the competition measured as the number of universities per region; Model 2 includes the competition measured as the inverse of the distance between universities in the same region; Model 3 includes the competition measured through the competitors' centrality index; Model 4 includes the competition measured through the competitors' centrality index adjusted for discipline overlapping. Models 5-8 show the results of the interaction of each measure of competition mentioned above, as well as the crisis.

	(1) Fees per student (ln)	(2) Fees per student (ln)	(3) Fees per student (ln)	(4) Fees per student (ln)	(5) Fees per student (ln)	(6) Fees per student (ln)	(7) Fees per student (ln)	(8) Fees per student (ln)
Fees per student t-1 (ln)	0.518***	0.498***	0.557***	0.527***	0.552***	0.663***	0.563***	0.549***
	(0.018)	(0.018)	(0.015)	(0.021)	(0.018)	(0.021)	(0.013)	(0.018)
Crisis	0.066***	0.068***	0.052***	0.053***	0.052***	0.046***	0.047***	0.059***
	(0.008)	(0.008)	(0.005)	(0.008)	(0.009)	(0.008)	(0.007)	(0.009)
State funding per student (ln)	-0.016***	-0.019***	-0.012***	-0.023***	-0.018***	-0.018***	-0.014***	-0.016***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Students aids (ln)	-0.003	-0.006**	-0.001	-0.003	-0.002	-0.002	0.002	-0.007**
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)
Size (ln)	0.042	0.029	-0.032	-0.104***	0.017	-0.100**	-0.043	-0.006
	(0.040)	(0.029)	(0.026)	(0.029)	(0.037)	(0.046)	(0.030)	(0.026)
Reputation	0.011	0.004	0.015	0.089	0.009	0.058*	0.037	0.001
	(0.037)	(0.035)	(0.039)	(0.057)	(0.038)	(0.030)	(0.041)	(0.027)
University per region (ln)	0.064***				0.071***			
	(0.008)				(0.009)			
Inverse of distance (ln)		0.048***				0.057***		
		(0.006)				(0.007)		
CompI (ln)			0.025***				0.039***	
			(0.004)				(0.006)	
Adjusted CompI (ln)				0.018**				0.053**
				(0.009)				(0.022)
University per region*crisis					-0.008**			
					(0.008)			
Inverse of distance*crisis						-0.025***		
						(0.006)		
CompI*crisis							-0.024***	
							(0.006)	
Adjusted CompI*crisis								-0.038***
								(0.028)
GDP per capita (ln)	0.172***	0.179**	0.203***	0.227***	0.186***	0.086**	0.187***	0.205***
	(0.055)	(0.069)	(0.068)	(0.056)	(0.047)	(0.069)	(0.056)	(0.053)
Share of non-regional students (ln)	0.818***	0.993***	0.636***	0.707***	0.973***	0.520***	0.671***	0.834***
	(0.042)	(0.048)	(0.029)	(0.042)	(0.031)	(0.072)	(0.042)	(0.037)
Constant	-0.268	0.479	0.905**	0.123	-0.903*	1.987***	0.457	1.202***
	(0.349)	(0.487)	(0.406)	(0.461)	(0.498)	(0.402)	(0.484)	(0.273)
YEAR DUMMIES	YES	YES	YES	YES	YES	YES	YES	YES
AR (2)	0.599	0.567	0.672	0.638	0.627	0.777	0.707	0.599
Sargan test	1.000	1.000	1.000	1.000	1.000	0.195	1.000	1.000
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Observations	649	649	649	649	649	649	649	649
Number of universities	59	59	59	59	59	59	59	59

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AB AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets.

Table 4. Reputation. This table reports the results of dynamic panel regressions on the level of tuition fees per student charged by 59 public Italian universities in the period between 2003 and 2014. Model 1 exhibits the moderating effect of reputation on crisis. Model 2 simultaneously shows the moderating effect of reputation on crisis and the moderating effect of competition on crisis. Model 3 and Model 4 illustrate the moderating effect of competition on the crisis by splitting the sample between ranked universities and non-ranked universities, respectively.[11]

	(1) Fees per student (ln)	(2) Fees per student (ln)	(3) Fees per student (ln)	(4) Fees per student (ln)
Fees per student t-1 (ln)	0.563***	0.563***	0.322***	0.599***
	(0.015)	(0.016)	(0.103)	(0.023)
Crisis	0.095***	0.054***	0.059**	0.047***
	(0.027)	(0.030)	(0.029)	(0.015)
State funding per student (ln)	-0.017***	-0.012***	0.608***	-0.026***
	(0.004)	(0.004)	(0.137)	(0.002)
Students aids (ln)	0.003	0.002	0.008	-0.006
	(0.003)	(0.003)	(0.006)	(0.008)
Size (ln)	-0.059	-0.078**	0.075	-0.156***
	(0.038)	(0.037)	(0.078)	(0.049)
Reputation	0.116	-0.002		
	(0.076)	(0.066)		
Reputation*crisis	0.563***	0.563***	0.322***	0.599***
	(0.015)	(0.016)	(0.103)	(0.023)
Adjusted CompI (ln)	0.065***	0.110***	0.034	0.049***
	(0.013)	(0.027)	(0.089)	(0.017)
Adjusted CompI*crisis		-0.068***	0.049***	-0.072***
		(0.020)	(0.069)	(0.012)
GDP per capita (ln)	0.225***	0.215***	0.363	0.188***
	(0.062)	(0.039)	(0.293)	(0.062)
Share of non-regional students (ln)	0.576***	0.556***	0.353	0.559***
	(0.041)	(0.037)	(0.306)	(0.074)
Constant	1.237*	1.538***	-5.183	2.526***
	(0.651)	(0.501)	(3.430)	(0.674)
YEAR DUMMIES	YES	YES	YES	YES
AR (2)	0.777	0.697	0.110	0.905
Sargan test	1.000	1.000	1.000	1.000
Hansen test	1.000	1.000	1.000	1.000
Observations	649	649	213	436
Number of universities	59	59	23	44

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AB AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets

Table 5. Chow test. In this table, we report the coefficients of the interaction between competitors' centrality index and a set of step dummy variables (coded 1) for each year between 2005 and 2014. A Chow breakpoint test over a range of dates (from 2003 to 2014) is used to calculate the F-statistic. The most likely date for a breakpoint is one that produces the highest F-statistic.

	(1) Fees per student (ln)	(2) Fees per student (ln)	(3) Fees per student (ln)	(4) Fees per student (ln)	(5) Fees per student (ln)	(6) Fees per student (ln)	(7) Fees per student (ln)	(8) Fees per student (ln)	(9) Fees per student (ln)	(10) Fees per student (ln)
Step dummy 2005	-0.073									
	(0.051)									
Adjusted CompI*Step dummy 2005	0.008									
	(0.005)									
Step dummy 2006		0.283***								
		(0.074)								
Adjusted CompI*Step dummy 2006		-0.027***								
		(0.008)								
Step dummy 2007			0.019							
			(0.052)							
Adjusted CompI*Step dummy 2007			0.001							
			(0.005)							
Step dummy 2008				0.324***						
				(0.091)						
Adjusted CompI*Step dummy 2008				-0.036***						
				(0.010)						
Step dummy 2009					-0.140***					
					(0.047)					
Adjusted CompI*Step dummy 2009					0.012**					
					(0.005)					
Step dummy 2010						0.091**				
						(0.045)				
Adjusted CompI*Step dummy 2010						-0.011**				
						(0.005)				
Step dummy 2011							-0.166***			
							(0.037)			
Adjusted CompI*Step dummy 2011							0.021***			
							(0.004)			
Step dummy 2012								0.035		
								(0.031)		
Adjusted CompI*Step dummy 2012								-0.003		
								(0.003)		
Step dummy 2013									-0.028	

									(0.033)	
Adjusted CompI*Step dummy 2013									0.002	
									(0.004)	
Step dummy 2014										-0.179***
										(0.028)
Adjusted CompI*Step dummy 2014										0.017***
										(0.003)
Observations	649	649	649	649	649	649	649	649	649	649
Number of universities	59	59	59	59	59	59	59	59	59	59
AR (2)	0.815	0.826	0.782	0.856	0.772	0.754	0.750	0.803	0.774	0.808
Sargan test	0.939	0.947	0.941	0.920	0.936	0.922	0.910	0.884	0.888	0.879
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AB AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets.

Table 6. Alternative measure of crisis. This table reports the results of dynamic panel regressions on the level of tuition fees per student charged by 59 public Italian universities in the period between 2003 and 2014. The unemployment rate is used as an alternative to the dummy crisis. Model 1 includes the Competitors' centrality index with discipline overlapping, and Model 2 includes the interaction with the crisis.

	(1) Fees per student (ln)	(2) Fees per student (ln)
Fees per student t-1 (ln)	0.716***	0.717***
	(0.019)	(0.016)
Unemployment (ln)	0.0761***	0.472***
	(0.006)	(0.176)
State funding per student (ln)	-0.028***	-0.028***
	(0.001)	(0.001)
Students aids (ln)	0.006***	0.006***
	(0.001)	(0.002)
Size (ln)	-0.113***	-0.084**
	(0.037)	(0.033)
Reputation	0.033	-0.005
	(0.046)	(0.044)
Adjusted CompI (ln)	0.020*	0.118**
	(0.080)	(0.052)
Adjusted CompI*unemployment (ln)		-0.044**
		(0.020)
GDP per capita (ln)	0.435***	0.398***
	(0.043)	(0.039)
Share of non-regional students (ln)	0.205***	0.255***
	(0.032)	(0.032)
Constant	-1.352***	-1.245***
	(0.470)	(0.335)
YEAR DUMMIES	YES	YES
AR (2)	0.799	0.795
Sargan test	0.287	0.309
Hansen test	1.000	1.000
Observations	649	649
Number of universities	59	59

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AB AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets

Table 7. Alternative model. This table reports the results of spatial dynamic panel regressions on the level of tuition fees per student charged by 59 public Italian universities in the period between 2003 and 2014. Model 1 exhibits the effect of competition. Model 2 shows the moderating effect of competition on crisis.

	(1)	(2)
	Fees per student (ln)	Fees per student (ln)
Fees per student t-1 (ln)	0.832***	0.761***
	(0.019)	(0.015)
Crisis	0.015***	0.021***
	(0.004)	(0.006)
State funding per student (ln)	-0.014***	-0.015***
	(0.002)	(0.002)
Students aids (ln)	-0.001***	0.004***
	(0.002)	(0.001)
Size (ln)	-0.120***	-0.331***
	(0.033)	(0.032)
Reputation	0.161***	0.067***
	(0.024)	(0.021)
Adjusted CompI (ln)	0.015	0.071***
	(0.018)	(0.015)
Adjusted CompI*crisis		-0.003***
		(0.001)
GDP per capita (ln)	0.179***	0.532***
	(0.064)	(0.094)
Share of non-regional students (ln)	0.121***	-0.127**
	(0.025)	(0.057)
Constant	0.333	-1.696*
	(0.551)	(0.909)
AR (2)	0.811	0.999
Sargan test	1.000	1.000
Hansen test	1.000	1.000
Observations	649	649

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets

Appendix

Definition of the competitors' centrality index.

The definition of the competitors' centrality index dates back to the work of Hotelling (1929), and has been referenced in several other studies since. This index accounts for distance of a university from its competitors in both physical (km) and operative terms:

$$F_{i,j,t} = O_{(Prov_{i,t})} D_{Univ_{j,t};ComPI_{j,t}} f_{(d_{i,j})}$$

Where:

$$ComPI_{j,t} = \sum_{\substack{m=1 \\ m \neq j}}^{N} (Univ_{m,t})\ f(d_{j,m})$$

$ComPI_{j,t}$ is the competitors' proximity index for university j in year t; N is the total number of other m institutions different from university j within the Italian HE context; $Univ_{m,t}$ represents the extent to which students are attracted to university m, and f ($d_{j,m}$) is a function of the Euclidean distance between university j and university m.

The intensity of the competition influences the distribution and flow of students; moreover, if the coefficient of the index is negative, competition is the dominant force at work, while if the coefficient is positive, the agglomeration effect prevails.

Definition of the competitors' centrality index with discipline overlapping.

Since two or more universities can be geographically close but too different to compete, $ComPI_{j,t}$ is corrected in terms of departments for the set of choices students face when the universities' educational offers are considered. In the Italian context, the department has been adopted as the level of analysis (see for example Cattaneo, Malighetti, et al., 2017), as it is a good proxy for the variety of the university's educational offering. According to the Law 240/2010, the department has become the internal organizational structure of Italian universities, unifying both teaching and research activities (Donina et al., 2015).

For each pair of universities, the departments in common are first identified:

$$DepOV_{i-j} = Dep_i \cap Dep_j$$

where $DepOV_{i-j}$ is the department overlap (weighted by the number of students enrolled in a given department) between university *i* and university *j*, where DEP_i stands for the departments of university *i* and DEP_j those at university *j*. Second, the overlapping index between universities *i* and *j* is computed by multiplying the relative shares of students enrolled in the departments of university *i* also existing at university *j*

$$IDepOV_{i-j} = \frac{\sum(Stud\ Univ_i) \in\ DepOV_{i-j}}{\sum(Stud\ Univ_i)}\ x\ \frac{\sum(Stud\ Univ_j) \in\ DepOV_{i-j}}{\sum(Stud\ Univ_j)}$$

As an example, the University of Bergamo and Milan Polytechnic are geographically close and compete for engineering students. Yet, only Bergamo provides courses in law, foreign languages, literature and communication studies, human and social sciences, and literature and philosophy, whereas only Milan Polytechnic has an architecture and design department. The first ratio is 0.14, calculated as the number of students enrolled in engineering at Bergamo (which is also offered by Milan) (344), relative to the total number of students (2449). Similarly, the second ratio (0.67) is measured excluding those students belonging to the departments of architecture and design (4415) in Milan. The product of these two ratios is used to weigh the competitors' proximity index.

The product of these two ratios $IDepOV_{m-j,t}$ is used to weigh the competitors' proximity index as follows:

$$ComPI_{j,t} = \sum_{\substack{m=1 \\ m \neq j}}^{N} (Univ_{m,t} IDepOV_{m-j,t})\ f(d_{j,m})$$

Additional robustness check

Table 8. Alternative measure of competition. This table reports the results of dynamic panel regressions on the level of tuition fees per student charged by 59 public Italian universities in the period between 2003 and 2014. Competition is measured by two alternative measures based on the number of publications (Model 1) and on the relative national recognition (Model 2), respectively. Competitors' number of publications is provided by Scopus database and the number of articles in national, regional, and local newspapers provided by the Factiva news media database.

	(1) Fees per student (ln)	(2) Fees per student (ln)
Fees per student t-1 (ln)	0.633***	0.651***
	(0.024)	(0.025)
Crisis	0.349***	0.195***
	(0.025)	(0.020)
Stare funding per student (ln)	-0.013***	-0.022***
	(0.004)	(0.001)
Student aids (ln)	0.002	0.002
	(0.004)	(0.003)
Size (ln)	-0.024	-0.087
	(0.046)	(0.059)
Reputation	0.017	0.066*
	(0.046)	(0.037)
GDP per capita (ln)	0.119*	0.180***
	(0.070)	(0.058)
Share of non-regional students (%)	0.461***	0.413***
	(0.060)	(0.097)
Competition publications (ln)	0.079***	
	(0.009)	
Competition publications*crisis	-0.055***	
	(0.005)	
Competition legitimacy (ln)		0.042***
		(0.005)
Competition legitimacy*crisis		-0.037***
		(0.005)
Constant	1.069*	1.314***
	(0.604)	(0.416)
YEAR DUMMIES	YES	YES
AR (2)	0.785	0.784
Sargan test	0.565	0.652
Hansen test	1.000	1.000
Observations	649	649
Number of universities	59	59

Notes: Standard errors included in parentheses. Significance level of 1 % (***), 5 % (**), and 10 % (*). Models include controls for lagged tuition fees. Models are estimated by system GMM using all available lags, and instruments are first-differenced regressors (as listed above) and lags of the outcome variable. AB AR(2) test is the p-value for the Arellano and Bond (1991) autocorrelation test of order 2. Overidentification test is the p-value for the Hansen (1982) J-test. Difference test is the p-value for the difference-in-Sargan test of the exogeneity of instrument subsets.

1 27 Italian private universities, six public doctoral universities, as well as three universities for foreigners, were excluded as their model of price setting is not comparable due to their different business models.

2 http://www.istruzione.it/

[3] The share of core-funding allocated according to the institutional performance increased from 7% to 20% between 2008 and 2015 (Donina et al., 2017).

4 To generate the dependent variable, we used the number of total students enrolled, rather than the number of paying enrolled students. This is due to the restraint of the percentage of Italians that are exempt (an average of 1% over the period). The University of L'Aquila, where the whole student body is exempt from paying tuition, represents the only notable exception. This is a consequence of the earthquake that hit the city of L'Aquila in 2009.

[5] Using the department as the level of analysis simplifies the investigation and objective because of the presence of a large variety of degree programmes in Italy, each of which is characterized by its own peculiarities. After the implementation of the Law 240/2010, the department became the internal organizational structure of Italian universities, which unifies both teaching and research activities (Donina et al., 2015). Adopting the department as the level of analysis allows us to take into account the disciplinary heterogeneity of the educational offerings in the Italian context (see for example Cattaneo, Malighetti, et al., 2017). An analysis at the micro-level would instead require the degree programmes as its level of analysis.

6 http://www.shanghairanking.com/

7 Natural logs of all variables, except dummies, are taken to interpret the results in terms of elasticity.

[8] We have tested the validity of the results by adopting a panel data model with university fixed effects. Results generally stayed stable.

[9] All regressions include standard errors clustered at the regional level, with year fixed effects, and with a standardized coefficient for competition. Results also stayed stable by adopting a panel data model with a university fixed effect.

[10] In the Appendix, we included an additional robustness test (Table 8) following the procedure in Cattaneo et al. (2019).

[11] During the period of investigation, some universities were ranked and some were taken off the rankings, such that they belonged to two different categories in different years.