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Abstract

This paper estimates neighbourhood effects in the local provision of higher education, and incorporates them in a welfare analysis of higher education supply. We use an own built dataset on the history of higher education institutions in Italy during 1861-2010 to implement an instrumental variables approach that exploits initial conditions in the pre-unitarian Italian states, interacted with post-unification comprehensive reforms of the university system. We provide robust evidence of local displacement between higher education supply in neighbouring provinces. These effects are mostly concentrated within the same field of study, the same region, and a spatial reach of 90 Km. We show that accounting for these displacement forces is important to evaluate the local economic returns of higher education supply. On average, higher education returns explain more than 4% of local value added per capita. Returns are very localised, and larger in provinces that host university hubs.

Keywords: neighbourhood effects; higher education supply; historical data; initial conditions; economic welfare.

JEL codes: I23, I28, N00, R1

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1 Introduction

Throughout the past century, OECD countries experienced a major expansion of their higher education (HE) systems, both in terms of students enrolled and number of institutions operating in the market. The economic returns of this process are generally associated with the accumulation of human capital e.g. due to higher shares of college graduates, with positive long-run effects on the economic welfare of countries (Hanushek and Woessmann, 2015). The social benefits of a large stock of human capital are likely to be very localised in cities and counties, particularly when workers and students have little mobility (Moretti, 2004, 2011; Hoxby, 2016). This is probably the reason why in many countries - particularly during the last few decades - the HE expansion entailed a decentralisation and differentiation of supply e.g. in terms of local autonomy and diffusion of HE provision (Eurydice, 2008).

Nowadays, such local engagement is viewed as a key factor for a successful HE design, as it allows to better tailor supply to regional development needs (OECD, 2007; OECD, 2014). The underlying argument is that the economic benefits of expanding HE supply are inherently local, i.e. similar to the advantages of large plant openings in a territory (Greenstone et al., 2010). However, little evidence has been presented so far to support this view. It may also be argued that benefits of local engagement come at a cost for surrounding territories. In fact, the establishment of a local HE provider in an area is meant to attract students and investments there. Since resources are scarce, this may displace supply elsewhere, i.e. reduce the possibility to open competing institutions in the neighbourhood. This, in turn, may help explaining the observed cross-regional differentials in productivity and income per capita (Gennaioli et al., 2013).

The literature that analyses the economic impacts of HE institutions is still limited, and falls short to provide an unanimous insight over these issues (Aghion et al., 2009; Andersson et al., 2004; Valero and Van Reenen, 2018). Our main objective is to fill this gap, by analysing neighbourhood effects and incorporating them into a welfare analysis of HE provision. We propose a novel empirical approach that combines historical data and exogenous reforms to identify neighbourhood effects and HE returns. We start by estimating the effect of HE supply in the neighbourhood (i.e. close provinces) on the local supply. Then, we predict the local economic returns of HE supply in terms of value added per capita, and evaluate their geographical distribution. In doing so, we are also able to quantify the magnitude of local effects, and net geographical externalities, which account for the opportunity cost of having HE institutions in neighbouring provinces.

We use data for Italy, which is the country with the longest history of university education in the Western world.[1] We construct and use an original panel on the History of Italian Universities (HIU). This covers 110 Italian provinces for 150 years from 1861 to 2010, when a major reform radically changed the governance of universities. The faculty is the relevant HE institution i.e. the teaching unit in a given field of study. Thus, for each province, we measure the local supply of HE as the total number of faculties in a given year. We define neighbourhood in terms of relationship between provinces based either on a contiguity, or a distance criterion, or both (see Parchet, 2018). The long time span of HIU data matched with an extensive set of province level controls enables us to account for many sources of heterogeneity.

We exploit variation coming from the geographical distribution of HE supply at the onset of Italian unification in 1861 to address endogeneity concerns (e.g. feedback effects, or omitted province level factors). This variation is arguably exogenous as it was inherited by the states that existed before the Italian unification (Squicciarini and Voigtländer, 2015). We interact these initial conditions with reforms of the HE system that occurred during Italian history, assuming that single Italian provinces do not have enough "voice" to influence state-level decisions, due to their weak political relevance.

Empirical results show that on average HE supply predicts 4.4% of local value added per capita. We find large inequalities between peripheral provinces that enjoy limited returns, and large provinces where supply of faculties explain up to 25% of local value added. We are able to disentangle the effect of local supply from the net geographical externalities that arise from faculties of neighbouring provinces. In particular, we find evidence of local substitution/displacement: 8 faculties more in the neighbourhood reduce local supply by about 1 faculty. Local displacement forces mostly operate within the same field of study, the same region, and a 90 Km linear distance. Once we account for the opportunity cost of such displacement forces, we find that economic returns are rather localised within each province, only one quarter being explained by geographical externalities for the neighbourhood.

The paper is organised as follows. In the next section we review the relevant literature and point out our contribution. In Section 3 we describe the institutional background and the data. The empirical analysis and main results of neighbourhood effects are in Section 4. Section 5 presents the welfare analysis. Section 6 concludes.

[1] In the Middle-Age university education was offered by a *Studium*, an autonomous organisation among students that chose and personally funded teachers through donations (*collectio*). Frequently, a *Studium* anticipated the foundation of a University (Pini, 2000). The University of Bologna dates back to the corresponding *Studium* established in 1088. Besides Bologna, by the *XII* century on the Italian territory there were active *Studia* in Modena (1175), Napoli (1224), Perugia (1308), Siena (1240), and Roma (1303). In Parma the first *Studium* (962) was closed in the *XII* century and then re-opened in 1601 (See Brizzi and Romano, 2007 for details).

2 Literature review

Our paper primarily contributes to the literature that investigates the long-term economic effects of education institutions. This literature looks at regional economic returns, investigating also the role of geographical externalities on productivity and growth. Andersson et al. (2004) use a 14-year panel dataset for Swedish municipalities to study the economic effects of HE decentralisation on output per worker. They find a positive association of local supply with productivity, and very localised externalities. Aghion et al. (2009) exploit variation in the appointment of US Congressmen in Appropriations Committees to identify the effect of education investments on economic growth in a panel of 48 US states during 26 cohorts. They find positive effects of education investments on growth, whose size depends on a state's distance from the technological frontier. Valero and Van Reenen (2018) use a novel dataset with regional panel information on nearly 15000 universities across 78 countries for the post-WWII period, and estimate fixed effects models at the sub-national level. While they do not have compelling instrumental variables to establish causality, they find robust evidence that increases in university presence are positively associated with subsequent economic growth.

We contribute to this literature in several respects. We use an empirical strategy that relies on initial conditions and exogenous reforms to identify the economic effects of education institutions. This empirical approach borrows from studies inspired by Unified Growth Theories (Galor, 2005), which adopt an historical perspective. These studies discuss the role of initial conditions in the stock of human capital as a crucial element for economic activity e.g. in France, Germany, Prussia, and UK (see respectively Squicciarini and Voigtländer, 2015; Cantoni and Yuchtman, 2014; Becker et al., 2011; Madsen and Murtin, 2017).[2] Our research design allows to analyse the economic effects of HE supply, accounting for its endogenous changes in a province.[3] In particular, our identification strategy is similar to Squicciarini and Voigtländer (2015). They exploit the exogenous cross-department distribution of subscriptions to the *Encyclopédie* in France to identify the impact of "upper-tail knowledge" on city growth after the onset of French industrialisation. We use historical data for Italy, going

[2]Cantoni and Yuchtman (2014) show that the establishment of Germany's first universities in the Middle Ages had a causal impact on medieval Europes Commercial Revolution. Becker et al. (2011) use the education level observed before the start of industrialisation (i.e. in 1816) as an instrument to identify the effect of education on industrialisation in Prussia. Similarly, Madsen and Murtin (2017) use 80 and 190 years lagged values of years of schooling to identify the impact of schooling on real GDP growth in the UK during 1270-2010. They show an important contribution of human capital accumulation (years of schooling) before and after the Industrial Revolution (this view is not undisputed; see for example, Clark (2005) for a discussion).

[3]In this respect, our paper also broadly relates to the literature that studies the long-run changes of education institutions. These studies address a research question complementary to ours i.e how institutional differences affect educational inequality (see e.g. Woesmann, 2003; Schutz et al., 2005; Braga et al., 2013).

back to the pre-unification period. This allows exploiting exogenous variation associated with initial conditions (i.e. pre-unitarian HE supply), which we use to make causal inference on neighbourhood effects in the provision of HE services, and their economic returns. The 150 years' time span of HIU data allows pointing out the long-term effects of HE supply.

We show that the presence of "incumbent" faculties in a sufficiently close neighbourhood of a province (e.g. in the same region, within a certain distance, etc.) displaces the creation of a faculty in a similar field of study there. This is a novel finding, which suggests that county-level competition may arise for the location of a new local HE institution, as for a new production plant (see e.g. Greenstone et al., 2010).[4] The final location is most likely to be influenced by factors such as local transportation infrastructures, the size and mobility of the potential network of students, etc. In that respect, we point out large productivity gains in metropolitan areas. Existing studies show these are generally associated with the clustering of firms and population (see e.g. Glaeser, 2010 for an overview); we find that very similar forces are also triggered by the clustering behaviour of HE institutions.

Our fine grained province level data enable us to advance in the measurement of the relative size of geographical externalities too. The literature does not provide an unanimous insight. Andersson et al. (2004) find a very limited role for externalities so that the benefits are mostly associated with local supply. Valero and Van Reenen (2018) show that local returns are equally determined by local and neighbours' supply. Aghion et al. (2009) find heterogeneous returns depending on relative closeness of HE investments to the technological frontier. Our estimates confirm that gross returns accruing to a province from neighbours' faculties are similar to returns from local supply (each equal to more than 2% of local VA, on average). However, we uncover that gross externalities neglect displacement effects. Once we account for them, net geographical externalities are smaller (about 1% of local VA), and three quarters of the economic returns stem from local faculties.

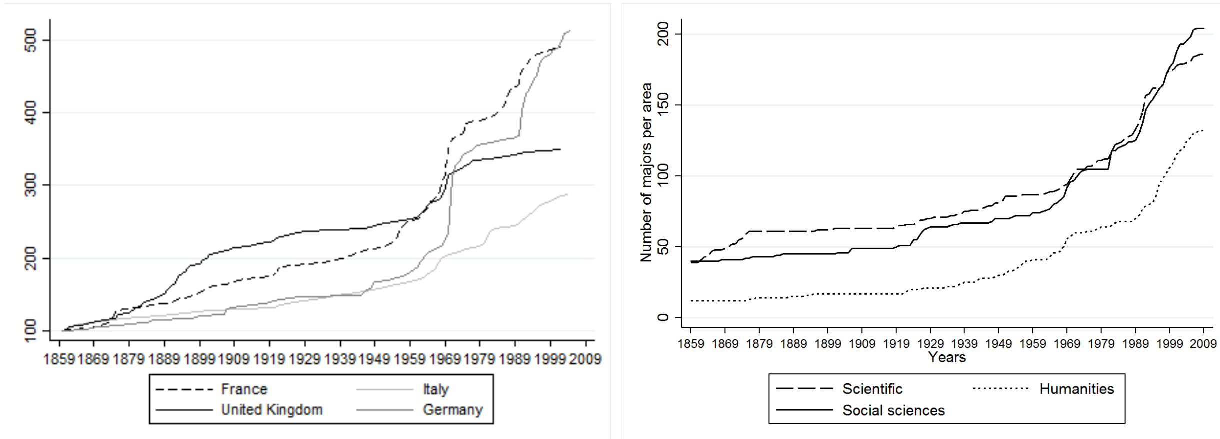
3 Institutional background and data

3.1 Institutional background

The evolution of HE supply in most European countries from the mid-nineteenth century exhibits a common pattern. Figure 1 describes the case of France, Italy, Germany and UK.

[4] The mechanism is inherently different though. In the latter case, competition is the outcome of the location decision of the plant itself. In the former case, we have rather yardstick competition where the decisor is the central government that chooses where to locate HE supply, having multiple options available.

Figure 1: Evolution of HE supply in EU4 during 1859-2009



(a) no. of universities in EU4

(b) no. of faculties by field of study in Italy.

Notes: Panel (a) presents the number of universities in EU4 (France, Germany, UK and Italy). This is an index equal to 100 in the first year (1859). Panel (b) reports the count of the number of faculties in Italy by field of study. Humanities include Education, Linguistic Studies, Literature, and Psychology. The STEM (i.e. Science, Technology, Engineering and Mathematics) group includes Agricultural Studies, Architecture, Chemistry and Pharmacy, Geology and Biology, Engineering and Scientific Studies. Social Sciences include Medical Studies, Economics and Statistics, Law, and Socio-Political Studies. Authors' calculations on HIU and WHED UNESCO data.

Panel (a) shows that all four countries are characterised by an increasing trend in the number of universities, especially starting from the 1960s. This pattern features the transition from elite to mass education, which took place in Europe and in the US during the same period (Eurydice, 1999; Smith, 2010), inducing a similar increase in education attainments (see e.g. Madsen and Murtin, 2017 for the UK). While it possesses a flatter profile relative to the other three countries,[5] the growth in Italy was substantial, and in 2009 the number of universities was about 3 times larger than in 1859. As detailed in Panel (b), the rise in HE supply after 1969 involved Humanities, STEM (i.e. Science, Technology, Engineering and Mathematics), and Social Sciences in a roughly similar way.

In line with European standards, HE providers in Italy are highly differentiated between old and new ones, large and small, public and private. The faculty is the institution that supplies HE in a given field of study. Its genesis is very often detached from that of a university, and there are many cases in which its creation is antecedent that of the university it belongs to. In pre-war period, this was due to institutional constraints as very few disciplines were formally taught within universities.[6] In the post-war period, the creation

[5]There are several reasons for this difference, for example the persistently lower number of high school graduates compared to countries like Germany, especially in the last 40 years.

[6]At the onset of Italian history there were only medicine, law, humanities, mathematics and natural

of new faculties was often supported by province-level *consortia*. These would convey local needs and demands, and gather all competences needed to the project: a HE provider (i.e. an existing university, not necessarily located in the same province, and willing to expand its market), financing institutions (banks, chambers of commerce or local investors), and local politicians enjoying direct connections with central government's representatives. Each *consortium* would present a faculty start-up project, which would then be evaluated by the central state. In the majority of cases, the project proposal would follow specific calls and development plans by the central state itself (Bratti and Leombruni, 2014).[7]

Traditionally, HE providers enjoy some degree of local autonomy, with a strong attachment to the territory and its economic and political stakeholders (OECD, 2008). The province has always been the relevant territorial unit for public good provision. On a historical ground, it is the oldest governance level on the Italian territory, inherited from pre-unitarian states. Provinces are equivalent to French departments and US counties, study-units for the local effects of human capital on industrialisation, production and wages (Squicciarini and Voigtländer, 2015; Ciccone and Peri, 2006, 2011; Bratti and Leombruni, 2014).

Table 1 presents the HE supply that the Italian Kingdom inherited by pre-unitarian states. It shows that the early Italian HE system was the simple aggregation of ancient pre-existing ones. In 1870, by the end of the main wave of Italian unification, there were more than 80 faculties already operating in the Kingdom. They were rather dispersed geographically, in 21 out of the 69 provinces of pre-unitarian states recognised as provinces of the newly born Italian Kingdom (we define them "pre-unitarian" provinces).[8] This initial supply of faculties was also very heterogeneous. The capital(s) of each pre-unitarian states had their own HE institutions (e.g. Palermo and Napoli in the Kingdom of the Two Sicilies). Capitals of old duchies, which used to be independent states during the Middle-Age had their own HE institutions too (e.g. the Duchies of Ferrara, Perugia and Pesaro Urbino). Each institution used to comply with the accreditation rules of its own state only. Also cultural fragmentation played a role: in 1861 only the 2.5% of the Italian population would be able to speak Italian, while the rest of the population would only use their local regional language (De Mauro, 1970).

sciences. Schools (equivalent to single faculty institutions) taught all scientific disciplines and the social sciences. The state recognised these schools as part of the broad HE system. Further details in the on-line Appendix, which is available at *https://sites.google.com/site/simoricon/*.

[7]Following this procedure, for example, in 1993 seven new faculties were opened in the Provinces of Novara, Vercelli, and Alessandria, as separate branches of the University of Torino. These gained autonomy in 1998, by the creation of the brand-new University of Eastern Piedmont. This case is not isolated, and several universities have faculties in multiple provinces (see on-line Appendix for details).

[8]Early Italian governments re-aggregated most provinces of pre-unitarian states in larger ones on the basis of political, economic, administrative and demographic considerations (Palombelli, 2012).

Table 1: Pre-unitarian HE supply

[1] Pre-unitarian Province	[2] Pre-unitarian state	[3] HE year of appearance	[4] No. of Faculties	[5] HE assessment Casati Law
Bologna	Papal states	1088	6	A
Cagliari	Kin. of Sardinia	1620	4	B
Catania	Kin. of two Sicilies	1445	4	B
Ferrara	Papal states	1391	4	private
Genova	Kin. of Sardinia	1481	5	B
Macerata	Papal states	1540	3	C
Messina	Kin. of two Sicilies	1838	3	B
Milano	Lombardy-Venetia	1791	2	A,A
Modena	Duchy of Modena	1175	4	B
Napoli	Kin. of two Sicilies	1224	7	A
Palermo	Kin. of two Sicilies	1806	4	A
Padova	Lombardy-Venetia	1407	4	A
Perugia	Papal states	1308	2	private
Pisa	Gran Duchy of Tuscany	1343	6	A
Parma	Duchy of Parma	962	5	B
P.Urbino	Papal states	1671	2	private
Pavia	Kin. of Sardinia	1361	5	A
Roma	Papal states	1303	5	A
Siena	Gran Duchy of Tuscany	1240	2	B
Sassari	Kin. of Sardinia	1765	3	C
Torino	Kin. of Sardinia	1404	8	A,B

Notes: In Column [3], HE year of appearance refers to the year of the first studium in the province. In Milano the first HE institution was the autonomous School of Veterinary Studies, although the University of Milan was established in 1924 only. Column [5] reports the quality assessment of HE institution(s) in the province according to the Casati Law. This evaluation refers to public institutions only. In Torino, the Casati Law assigns A-score to the University of Torino, and a B score to the Polytechnic. In Milano, it assigns A-score to both the Scientific Academy, and the Polytechnic. Source is History of Italian Universities (HIU) Data.

This heterogeneity emerged from the Law 3725/1859 (called Casati, from the name of the Minister of Education).[9] The Law contained an assessment of HE institutions, as reported in Column [5] of Table 1. In 9 provinces, HE supply was ranked "A", as local institutions fully complied with the highest quality standards. In several provinces, local universities were ranked "B", as they would not match the highest quality standards, but provided second-tier regional institutions. Universities of Sassari and Macerata fell short of the minimum requisites and were ranked "C". The Casati Law also acknowledged private HE provision in the provinces of Ferrara, Urbino and Perugia, where the Dukes used to directly patronise local universities (Brizzi and Romano, 2007).

Italian governments before WWII put a lot of effort to harmonise pre-unitarian HE sys-

[9]This law set out the rules for accrediting pre-existing institutions into the new Italian university system. It was initially applied to new territories of the Kingdom of Sardinia. The successive Matteucci Law in 1862 extended it to all territories that gradually entered the Italian Kingdom.

tems into a homogeneous national one. The Law 2102/1923 (called Gentile, from the name of the Minister of Education) was the first attempt to create an organic and coherent framework, featuring the opportunity to open new faculties, especially in scientific and applied fields.[10] The reform also restored the distinction between A-level and B-level HE institutions, which had been progressively excised over the years (see on-line Appendix for details). The reform launched by the Law 1592/1933 (called De Vecchi-Bottai) with subsequent ancillary interventions, created a more overarching and centralised HE system. It nationalised private universities and recognised technical and applied schools as faculties with full academic status.

Post-WWII reforms produced a new institutional setting. The national university system, which was previously organised to serve the "elite", later on was designed to provide schooling for the "mass ". The Law 910/1969 liberalised access to students with a 5 year diploma of secondary education from technical schools (that before 1969 were not allowed university enrolment). The consequent rise in demand for tertiary education put pressure on the national university system to adapt its supply. Indeed, the Law 766/1973 legislated the opening of new faculties and increased the number of faculty hires. The Law 382/1980 reorganised the internal governance of universities, as well as the recruitment and career of university professors. Successive Laws 392/1989 and 245-341/1990 modified the allocation of funding to HE.[11] The Law 59/1997 granted universities more financial and teaching autonomy.

3.2 Data and descriptive statistics

Our main data-source is an original dataset on the History of Italian Universities (HIU). This is an own compiled register that contains detailed information on institutions providing university education in Italy, disaggregated at the faculty level. The dataset covers all years starting from 1861 (year of birth of the Kingdom of Italy) up to 2010, when the Law 240/2010 eliminated the faculty from the governance of public universities.

Our primary source to construct HIU is Brizzi and Romano (2007), which reports detailed history of Italian universities starting from their foundation. We integrated this information by several sources on the history of specific universities (see e.g. Fois, 1991, on the University of Sassari), and faculties (e.g. Silvestri, 2006, on engineering). We also heavily relied on

[10] The reform introduced new disciplines, and granted academic status to technical studies. In this way, it expanded the perimeter of the higher education system to include specialised schools in technical disciplines such as engineering and architecture, economics, management, commercial and social sciences.

[11] The Law established a dedicated "Ministry of Universities and Scientific and Technological Research", and set up triennial development plans for universities (see on-line Appendix for details).

Gazzetta Ufficiale della Repubblica Italiana, a weekly publication that collects every public act taken by the government since 1861. We double-checked all information against those provided by open-source archives i.e. Wikipedia, universities' and faculties' websites.[12] To fill the few missing information, we contacted the administrative representatives of the faculty. Finally, we validated the data against the current university list provided by the Italian Ministry for University, Education and Research (MIUR).

The register includes the name of the faculty and its current address; 15 faculty field identifiers, which we aggregated into 3 macro-areas of science (Social Sciences, STEM, and Humanities), according to the classification used by the Italian National Statistical Office. It also includes the year when the faculty appears as a legally recognised provider of HE, information on the type of governance (private or public), and quality assessments by the national government (in A,B,C-level) with their over-time changes (See Appendix A.1 for details).

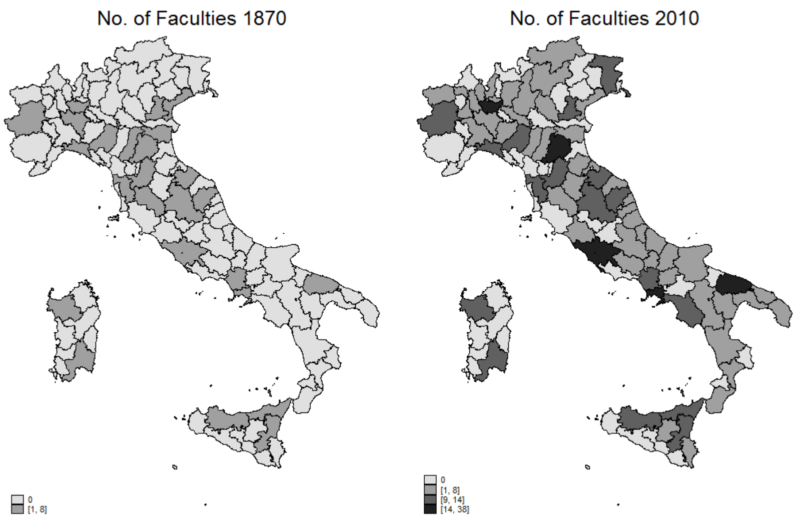
We consider only HE institutions offering standard BSc education.[13] Our initial HIU sample includes 574 faculties (in 71 universities) registered in the Italian territory at some point between 1861 and 2010. We use this sample to construct a province level panel which counts the number of faculties present in each province and year. The panel is unbalanced because the number of provinces changes throughout the time span. We exclude the first 10 years, as the Italian unification process was still ongoing. The final province level panel dataset includes 11792 observations for 110 provinces between 1870 and 2010. The main variable is the number of faculties in province i, as a total and by macro-area of science. We also record information on the total number of universities, private universities, and A,B,C-level universities in province i at time t.

Figure 2 gives an historical overview on the total number of faculties in 1870 as compared to 2010 (at the 2010 province disaggregation level, for comparability purposes). As early as 1870, the distribution of faculties was concentrated in the capitals of pre-unitarian states, with the highest number being 8 in Torino (compare Table 1). In 2010, almost all provinces had at least one faculty. Those with 0 faculties are the most recent provinces, established in the post-WWII period. Few provinces displayed a HE supply of 15 faculties or more (Bari,

[12]Since faculties no longer exist after 2010, their websites are not readily available on the web today. We retrieved them using Wayback Machine (*https : //web.archive.org/*), a digital archive of the World Wide Web created by the Internet Archive.

[13]Thus, we do no consider universities offering only post-graduate education, single courses or enrolling foreign students only. These are: Universita' di Scienze Gastronomiche, Universita' Europea di Roma, Universita' Normale di Pisa, Scuola IMT Alti Studi di Lucca, Scuola superiore di studi universitari e perfezionamento "S. Anna" di Pisa, Universita' degli studi di Roma "Foro Italico", Istituto universitario di studi superiori di Pavia, Scuola internazionale superiore di studi avanzati di Trieste, Universita' per Stranieri di Siena, Universit per Stranieri di Perugia.

Figure 2: Diffusion of faculties in Italy



Notes: Authors' calculation on HIU data, using map of Italian provinces in 2010.

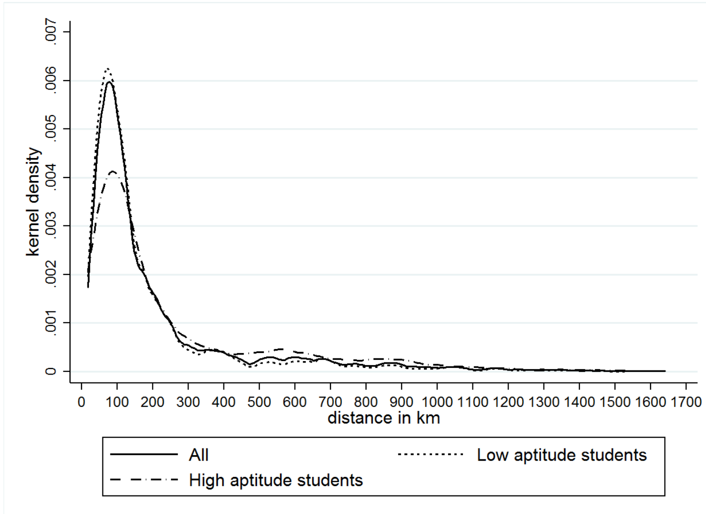
Bologna, Milano, Napoli, and Roma).

This expansion may be the outcome of spatial or yardstick competition when the locations of students and HE institutions are endogenous. A dispersed HE supply is designed both to "retain" local students, and attract students from close locations, by supplying their preferred degree (say in a given field of study, or by a specific institution). This is especially true when students have low mobility (i.e. high commuting cost). Figure 3 reports the distribution of high school graduates in Italy by distance from the university they enrolled to. It suggests that students' mobility is very low indeed: the majority of Italian high school graduates chooses a HE institution at a distance of about 100 Km. Mobility is higher among students with high aptitudes towards HE and it is particularly low among low aptitude students. This recalls well known results for the US (see Hoxby, 2016).

We construct several matrices to model spatial interactions between neighbouring provinces. The baseline analysis uses a *contiguity* matrix: neighbours js are those provinces that share a border with province i, and we give them the same weight regardless of their distance from i. We also use alternative matrices based upon linear distance, travel distance, and travel time (see Appendix A.2). Notice that all these approaches feature heterogeneous neighbourhood relationships, which are immune to Manski (1993)'s reflection issues.[14]

[14] The reflection problem arises when interactions occur in a fixed "reference group". As neighbourhood relationships (e.g. based on distance, contiguity, travel time etc..) imply that each Italian province interacts in a different way with all other provinces, reference groups differ for different provinces. By definition, these groups only partially overlap because the sets of neighbours of two provinces do not perfectly coincide. See De Giorgi et al., 2010 for a detailed discussion in the context of social interactions.

Figure 3: Students' mobility and choice of HE institution.



Notes: Authors' calculations on data from the Italian survey of high school graduates, 2007 (ISTAT). We define students' aptitude using their final grade at lower secondary schools, which is set on a four point scale. High aptitude students are those with the highest grade (4), while low aptitude students are those with the lowest grades (1 or 2).

Table 2 presents summary statistics for the main variables. Panel A describes local HE supply. On average, each province has a supply of over 2.5 faculties, mostly in STEM and Social Sciences. It has about 0.5 universities, of which the 15% are private, and over the 75% are classified as A-level.[15] Panel B reports HE supply of the "average neighbour" $-i$, computed as the average of the HE supply of all neighbours of province i, based on the contiguity matrix. A representative neighbour, on average has about 2.9 faculties; other figures are similar to those displayed in Panel A. Panel C reports the HE supply of each individual neighbour j. Allowing pairwise relationships between provinces i and j, increases the sample size by roughly four times (as each province i has roughly four neighbours js, on average), and avoids averaging down the HE supply of neighbours (as shown by comparing the maximum no. of faculties in Panels B and C). We also collected information on real value added per capita (constant 1911 prices), and other province level historical indicators which we will use as controls in our estimations (see Panel D). More info can be found in Appendix A.3.

[15]The high percentage of A-level universities is due to the fact that the De Vecchi-Bottai Reforms, starting from 1933 classify all public universities as A-level.

Table 2: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Panel A: Local HE Supply					
no. of faculties in i	2.515	4.153	0	38	11792
no. of humanistic faculties in i	0.479	0.99	0	11	11792
no. of stem faculties in i	1.07	1.752	0	9	11792
no. of social sciences fac. in i	0.959	1.66	0	19	11792
no. of universities in i	0.497	0.842	0	7	11792
no. of private universities in i	0.078	0.364	0	4	11792
no. of A-level universities in i	0.381	0.621	0	3	11792
Panel B: HE Supply of average neighbour, $-i$					
no. of faculties in $-i$	2.884	2.168	0	17.333	11792
no. of humanistic faculties $-i$	0.536	0.544	0	4.333	11792
no. of stem faculties in $-i$	1.24	0.909	0	5	11792
no. social sciences fac. in $-i$	1.098	0.873	0	8.333	11792
no. of universities in $-i$	0.551	0.398	0	2.667	11792
no. of private universities in $-i$	0.089	0.196	0	1.333	11792
no. of A-level universities in $-i$	0.422	0.31	0	1.667	11792
Panel C: HE Supply of neighbour, j					
no. of faculties in j	2.85	4.43	0	38	50803
no. of humanistic faculties in j	0.537	1.062	0	11	50803
no. of stem faculties in j	1.212	1.837	0	9	50803
no. social sciences fac. in j	1.091	1.783	0	19	50803
no. of universities in j	0.546	0.895	0	7	50803
no. of private universities in j	0.093	0.415	0	4	50803
no. of A-level universities in j	0.418	0.639	0	3	50803
Panel D: Province level characteristics					
Real per capita VA (entire sample)	0.838	0.84	0.15	3.933	1080
Population	566360	506697	102497	4018108	1012
Population 0-14 years old	110888	118763	10580	853007	674
Participation rate	45.456	8.379	3.978	98.424	1012
% of active individuals in industry	27.519	17.11	4.742	436.068	1012
% with tertiary education	3.983	3.554	0.416	16.804	681

Notes: Authors' calculation on HIU data. Panel D includes information taken from 16 waves of National Census data 1861-2009, ISTAT and Istituto Tagliacarne. Real per capita VA expressed in euros, at 1911 constant prices.

4 Neighbourhood effects on HE supply

In this section we analyse the effect of the HE supply in the neighbourhood on the local supply in a province.

4.1 Empirical strategy

We specify the HE supply F in the i-th Italian province at time t as function of the HE supply in the neighbourhood using a linear spatial competition model based on geographical contiguity, where neighbours are all provinces j that share a border with i. We define these spatial interactions in two complementary ways. We start by assuming that HE supply in province i depends on that of its "average neighbour". This is defined as $\overline{F}_{-it} = \sum_{j \neq i}^{N_i} w_{ij} F_{ij}$ (Brueckner, 2003). All neighbours have the same weight: $w_{ij} = \frac{1}{N_i}$ where N_i is the number of contiguous provinces of i. We model this relationship as follows:

$$F_{it} = \alpha + \beta \overline{F}_{-it} + \gamma_i + \delta_{r(i)t} + (X_{it}\phi) + \epsilon_{it}, \tag{1}$$

where β is the coefficient of interest. γ_i and $\delta_{r(i)t}$ are, respectively, province and region-by-year fixed effects (where $r(i)$ refers to the region province i belongs to at time t). X_{it} is a vector of time varying province level covariates. This includes the total number of universities, number of private and A-level universities in the province. In several specifications we also include demographic and economic controls that account for potentially spatially correlated factors e.g. related to local demand for HE at the province level.[16]

To better account for the omitted determinants of province i's HE supply (e.g. related to geographical factors) that are spatially correlated with those of its neighbours, we also estimate a "pairwise" version of equation (1). This takes the form (see Parchet, 2018):

$$F_{ijt} = a + bF_{jt} + c_{ij} + d_{r(i)jt} + (X_{ijt}f) + e_{ijt}. \tag{2}$$

F_{jt} is the HE supply in each neighbouring province j of province i. Equation (2) can be estimated for all contiguous ij pairs. Each couple appears twice, with a given municipality being once on the left-hand side and once on the right-hand side of equation (2). b captures the average effect of each neighbour j's HE supply on the local supply of province i. c_{ij} is the fixed effect of the pair. Relative to equation (1), the inclusion of pair fixed effects allows to better account for the time-invariant omitted factors that pertain to each ij couple.

The heterogeneity that is left after the inclusion of the province (or province pairs) and region-by-year fixed effects in equations (1) and (2) is the variability over time across provinces within the same region. Identification of β and b in equations (1) and (2) respectively is obtained through the comparison of different time-varying patterns in the number of faculties across provinces.

Our main indicator of HE supply is the total number of faculties in province i and in the

[16] In Table 7 below we include the size of total population, population in the 0-14 age cohort, population share in tertiary education, and size of the industry sector. We did not include these variables to the baseline specification as they are available from the Italian Census every ten years, in some cases for the post-war period only. Moreover, due to their persistence over time, they are not immune to endogeneity concerns.

neighbourhood (i.e. the average neighbour $-i$ in equation (1), or each neighbour j in equation (2)). Throughout the analysis, we use other indicators too. We distinguish the extensive margin (i.e. having at least one faculty in province i and in the neighbourhood) from the intensive one (i.e. number of faculties, where HE supply is available). We also measure HE supply as the number of universities available in province i and its neighbourhood. In both models (1) and (2), a key aspect is the definition of neighbouring provinces. As mentioned above, in the baseline specification we use a contiguity matrix. We also implement alternative neighbourhood's definitions based on linear distance, travel distance, travel time, and compute the "spatial reach" of neighbourhood effects (Parchet, 2018).

Finally, equations (1) and (2) assume contemporaneous spatial competition. As discussed in Section 3 above, several actors are involved in the decision of opening a new faculty, which implies some delay in the effect of neighbours on local HE supply. In our preferred empirical specification, we model neighbourhood effects as a ten years' lag.

Identification and estimation issues. The main issue in the estimation of equations (1) and (2) is reverse causality. The number of faculties of a neighbouring set of provinces itself depends on the number of faculties of province i. For example, in Equation (2) any change of F_{ijt} may induce an adjustment of F_{jt} in each neighbour. Moreover, many time-varying determinants of one province's number of faculties are likely to be unobservable and spatially correlated, such that $cov(e_{ijt}, F_{ijt}) \neq 0$. This would for example be the case of local economic conditions, demand for higher education, or spatially correlated shocks. Even if these are region specific, they are not captured by region-by-year fixed effect, as long as not all neighbours belong to the same region as province i. The average neighbour model (1) suffers from the same endogeneity problems.

To deal with endogeneity concerns, we use instrumental variables (IV). Our instruments are $Z_{jt} = ICj * R_t'$, where ICj is the number of faculties of each neighbouring province at the onset of Italian unification, and R_t is a vector of state-level university reforms such that $R_t = 1$ if $t \geq$ reform year, and 0 otherwise. Thus, for the pairwise model (2) we specify a regression for the first stage where F_{jt} is a function of Z_{jt}. These Z_{jt} instruments convey the idea that, while state-level reforms affect all provinces, the same general reform may shape HE supply of each province j differently, depending on its "pre-unitarian endowment". The idea is that, at any t, each province j faces a university system that is the result of the stratification of current and past reforms. This layering process is measured by the number of laws active in a given year. Identification comes from the number of reforms at which at time t each province j has been exposed since the first year it appeared in the sample, interacted with its initial endowment of faculties, provided that this is non-zero. The first stage specification of model (1) is similar, except that it involves $\overline{F}_{-it}$ and $\overline{Z}_{-it}$.

Besides implying enough variation in neighbours' supply, instruments need to be exogenous to HE supply in province i, i.e. $cov(Z_{jt}, e_{ijt}) = 0$ in equation (2), and $cov(\overline{Z}_{-it}, \epsilon_{it}) = 0$ in equation (1). This exogeneity assumption must hold for both initial conditions and reforms. As discussed in Section 3 above, the geographical distribution of faculties in pre-unitarian Italian states reflected their HE policies, which in most cases dated back to medieval times. Pre-unitarian states were culturally and linguistically fragmented. They were often in political conflict, and had their own institutions. Thus, it is very unlikely that they would coordinate their decisions in any area of public good provision. With the Casati framework, the newborn Italian Kingdom simply inherited the set of HE institutions that pre-unitarian states had designed independently in the past.

As for the reforms, we focus on laws with a general purpose and not intended to regulate some specific need of a limited set of universities. The key point for identification is whether (upper-level) state decisions are exogenous to the provinces. This exogeneity holds under two identifying assumptions. The first one is that state-level reforms are not driven by unobserved time-varying factors that also affect the number of faculties in the province i and its neighbours. This means assuming that region-by-year dummies capture all the aggregate component of province-specific shocks. The second requirement is that individual provinces do not systematically affect state-level HE policies. It is unlikely that any province has enough "voice" and bargaining power to direct national interest reforms of the governance of Italian university system. Provinces have very limited legislative competences and their political relevance was always questioned during Italian history.[17] Moreover, on the Italian territory there is a sufficiently high number of provinces and the population is dispersed enough, to prevent a specific province from having enough political power to influence state-level decision. In a robustness exercise we address potential feedback effects from large provinces to national policy-making, and exclude provinces hosting a metropolitan city (see Table 7 below).

[17] The Republican Constitutional Law does not mention the exact tasks and competences of provinces. It only states (art. 114) that they are autonomous bodies (as well as municipalities, metropolitan cities, and regions) with their own statutes, powers and functions according to the principles established by the Constitution (See also Fabrizzi, 2008a, 2008b, 2008c for historical overviews). Nowadays, provinces are considered the relevant jurisdictions for decisions on the supply of local public services. Petracchi (1962) defines them "big associations of municipalities devoted to the protection of the rights of each of them, and to the management of their collective moral and material interests".

4.2 Empirical results

Table 3 presents estimates of equation (1) in Panel A and equation (2) in Panel B. Rows (a) shows the effect of the number of faculties in the "average neighbour" of province i on the number of faculties in province i at time t. In Rows (b), we describe HE supply in each province as a dummy variable, which is equal to 1 if at least one faculty is present in the province at time t, 0 otherwise (the "extensive margin" of neighbourhood effects). In Rows (c), we describe neighbourhood effects only between provinces that have at least one faculty at time t (the "intensive margin"). Finally, in Rows (d) we measure HE supply in terms of the number of universities (rather than faculties) operating in each province. We present results of four different specifications. In Column [1] we use OLS, with province fixed effects (OLS FE). In Column [2] we add year fixed effects. In Column [3] we include region-by-year fixed effects. In Column [4], we add province level controls. Standard errors are always clustered by province.

Estimated coefficients for the average neighbour model of Panel A turn from positive in Column [1] to negative in Column [4], for all measures in Rows (a)-(d). This is mostly due to the inclusion of region-by-year FE, which allows to control for large regional inequalities in the evolution of HE provision (Di Martino and Vasta, 2017). Estimates in Row (a) suggest that an increase in neighbourhood's number of faculties is associated with a lower number of faculties in province i, this effect being significant at the 1% level. Results of the "pairwise model" (2) in Panel B are qualitatively very similar to average neighbour estimates: an increase in HE supply in a neighbouring province j is negatively associated with HE supply in province i for all measures in Rows (a)-(d). As expected, accounting for time invariant omitted factors that pertain to each neighbouring pair (i.e. the pair fixed effects) reduces the size of the coefficients.

Tables 4 and 5 present results of the two stages of the IV FE model. We use the baseline specification with the complete set of fixed effects and provincial controls (Row (a), Column [4] of Table 3). In Panels A and B of both tables we report estimates for the average neighbour and pairwise approaches, respectively. In Column [1], we present results for all 110 provinces.[18] In Column [2], we focus on the 69 pre-unitarian provinces. This is meant to avoid reverse causality e.g. going from public policy to the creation of new provinces. Finally, in Column [3], we acknowledge that the effect of province j on HE supply of province i is not instantaneous, and allow for a 10 years' lagged effect of neighbours.

First stage estimates in Table 4 show that reforms interacted with neighbours' initial

[18] Accordingly, in IV FE estimates we set to zero the initial conditions of the 41 provinces that were created during the Italian history.

Table 3: Neighbourhood effects on higher education supply

	[1]	[2]	[3]	[4]	Obs.
Panel A - Average neighbour approach					
(a) average no. of faculties in $-i$	0.59***	–0.14	–0.76***	–0.48***	11383
	(0.11)	(0.10)	(0.25)	(0.14)	
(b) at least one faculty in $-i$	0.31***	0.18*	–0.24*	–0.21**	11383
	(0.11)	(0.10)	(0.12)	(0.09)	
(c) average no. faculties in $-i$ (int. margin)	1.27***	0.07	–0.86	–0.47	4064
	(0.32)	(0.12)	(0.53)	(0.30)	
(d) average no. of universities in $-i$	0.43***	0.21**	–0.82***	–0.82***	11383
	(0.10)	(0.10)	(0.27)	(0.27)	
province FE	yes	yes	yes	yes	
year fixed effects	no	yes	no	no	
region-by-year FE	no	no	yes	yes	
provincial controls	no	no	no	yes	
Panel B - Pairwise approach					
(a) no. of faculties in j	0.37***	-0.03	–0.14**	–0.08***	50803
	(0.06)	(0.03)	(0.03)	(0.04)	
(b) at least one faculty in j	0.35***	0.13***	–0.07**	–0.04*	50803
	(0.06)	(0.04)	(0.03)	(0.02)	
(c) no. of faculties in j (int. margin only)	0.73***	0.02	–0.16**	–0.05***	22728
	(0.15)	(0.05)	(0.06)	(0.02)	
(d) no. of universities in j	0.25***	0.10**	–0.13**	–0.13**	50803
	(0.06)	(0.04)	(0.06)	(0.06)	
provincial pair FE	yes	yes	yes	yes	
year fixed effects	no	yes	no	no	
region-by-year FE	no	no	yes	yes	
provincial controls	no	no	no	yes	

Notes:. In Rows (a) and (c) the dependent variable is the total number of faculties in province i. In Row (b) the dependent variable is a dummy equal to 1 if at least one faculty is active in province i, 0 otherwise. In Row (d), the dependent variable is the total number of universities active in province i. The set of controls include the total number of universities (not included in specification (d)), the number of A-level universities, and private universities in province i. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

conditions have a positive impact on their own supply of faculties. Significance is generally higher in Panel B compared to Panel A, due to the smaller standard errors of pairwise estimation. Summing up the significant coefficients from pairwise estimates suggests that reform effort that took place during Italian history induced each neighbouring province with a pre-unitarian HE supply to open about one faculty. Unsurprisingly, the most relevant reform is Law 910/1969, which liberalised university access. On the whole, our IV FE model exploits one big discontinuity in 1969 plus additional smaller discontinuities.

Table 5 presents results for the second stage. We also present OLS FE counterparts from Table 3 to ease comparison. Coefficients estimated under pairwise approach are smaller than their average neighbour counterpart. They are also more precisely estimated and stable

Table 4: First stage of IV estimates: initial conditions, reforms and HE supply.

	[1]	[2]	[3]
Panel A - Average neighbour approach			
(IC_{-i})*(L. 2102/1923)	0.19	0.21	0.25
	(0.16)	(0.16)	(0.16)
(IC_{-i})*(L. 1592/1933)	–0.04	0.24	0.26
	(0.10)	(0.18)	(0.17)
(IC_{-i})*(L. 910/1969)	0.21***	0.31***	0.30***
	(0.05)	(0.08)	(0.08)
(IC_{-i})*(L. 766/1973)	0.09**	0.06*	0.06*
	(0.04)	(0.04)	(0.04)
(IC_{-i})*(L. 382/1980)	0.07	0.03	0.03
	(0.04)	(0.05)	(0.05)
(IC_{-i})*(L. 168/1989)	0.04	0.04	0.04
	(0.03)	(0.05)	(0.05)
(IC_{-i})*(L. 245-341/1990)	0.19***	0.07	0.06
	(0.10)	(0.10)	(0.10)
(IC_{-i})*(L. 59/1997)	0.26***	0.20	0.09
	(0.09)	(0.16)	(0.12)
Observations	11383	8626	8614
Panel B - Pairwise approach			
(IC_j)*(L. 2102/1923)	0.11***	0.12***	0.15***
	(0.04)	(0.04)	(0.04)
(IC_j)*(L. 1592/1933)	0.10***	0.13***	0.15***
	(0.03)	(0.03)	(0.02)
(IC_j)*(L. 910/1969)	0.22***	0.25***	0.24***
	(0.02)	(0.02)	(0.02)
(IC_j)*(L. 766/1973)	0.05***	0.05**	0.06***
	(0.02)	(0.02)	(0.02)
(IC_j)*(L. 382/1980)	0.05***	0.02	0.01
	(0.02)	(0.01)	(0.02)
(IC_j)*(L. 168/1989)	0.04***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)
(IC_j)*(L. 245-341/1990)	0.21***	0.13***	0.13***
	(0.04)	(0.03)	(0.03)
(IC_j)*(L. 59/1997)	0.26***	0.18***	0.14***
	(0.04)	(0.05)	(0.03)
Observations	50803	35510	35060

Notes: First stage of IV FE estimates reported in Table 5. Dependent variable is F_{-it} in Panel A and Fjt in Panel B. All specifications include the usual set of fixed effects, and provincial controls. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

across OLS FE and IV FE specifications. F-statistics confirm that instruments have strong predictive power in the first stage of pairwise estimates, much less so under the average neighbour approach. The Hansen test confirms instruments provide valid exclusion restrictions in the second stage. Results show a sizeable negative effect of neighbourhood on local

Table 5: IV estimates: neighbourhood effects in higher education supply (2^{nd} stage).

	[1] baseline sample		[2] pre-unitarian provinces		[3] pre-unitarian prov. (lagged 10 y.)	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
Panel A - Average neighbour approach						
total no. faculties in $-i$	–0.48***	–1.14***	–0.09	–1.08**	–0.11	–0.94*
	(0.14)	(0.39)	(0.08)	(0.49)	(0.10)	(0.50)
Observations	11383	11383	8626	8626	8614	8614
K-P rk Wald F-stat		7.167		3.838		3.905
Hansen J-stat		7.636		4.017		4.475
(p-value)		0.366		0.778		0.724
Panel B - Pairwise approach						
total no. faculties in j	–0.08***	–0.16***	–0.04**	–0.13**	–0.05*	–0.12***
	(0.03)	(0.05)	(0.02)	(0.06)	(0.02)	(0.04)
Observations	50803	50803	35510	35510	35060	35060
K-P rk Wald F-stat		35.474		25.864		22.231
Hansen J-stat		1.644		6.282		3.620
(p-value)		0.977		0.507		0.822

Notes:. Regressions in column [1] exploit the baseline sample i.e. 110 provinces during the entire period 1871-2010. Regressions in column [2] cover only the set of 69 pre-unitarian provinces for the entire period. Regressions in column [3] cover pre-unitarian provinces during the entire period and take 10 years lags of regressor and controls. Specifications in Panel A include province fixed effects. Specifications in Panel B include province pair fixed effects. All specifications include region-by-year fixed effects, and the usual set of provincial controls. In IV estimates the total no. of faculties in province $-i$, j is instrumented by the initial conditions (i.e. number of faculties in $-i$, j in 1861) interacted by a battery of dummies for higher education reforms in Italy. The full set of coefficients is in Table B-2 in the Appendix. The full set of first stage coefficients is in Table 4. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

HE supply. This suggests that HE supply by neighbouring provinces "displace" local supply (as they are very close substitutes). Using as benchmark pairwise results in column [3], an increase of 8 faculties in the neighbourhood decreases local HE supply by $0.96 = (-0.12 * 8)$ faculties. Considering that each Italian province has 4 neighbours on average, this effect would be triggered by each neighbour setting up 2 new faculties.[19]

4.2.1 Neighbourhood effects across and within fields of study

In Table 6, we analyse neighbourhood effects within and between fields of study. We group all faculties into three major groups i.e. Humanities, STEM, and Social Sciences. We run three sets of regressions (Panels A-C), where our dependent variables are the local supply in Humanities, STEM, and Social Sciences, respectively. In Columns [1] and [3], we show

[19] Results do not change when we drop all provinces that host multicampus Universities (Beine et al., 2018). These are available upon request by the authors.

Table 6: Cross-disciplinary neighbourhood effects: humanities, stem, social sciences

	[1]	[2]	[3]	[4]	[5]	[6]
	OLS FE	OLS FE	IV FE	IV FE	IV FE	Obs.
Panel A - Humanities						32644
faculties$_j$, Humanities	–0.06*	–0.07*	–0.02	–0.07*	–0.08*	
	(0.04)	(0.04)	(0.07)	(0.04)	(0.04)	
faculties$_j$, STEM		0.01		–0.02	–0.03	
		(0.02)		(0.03)	(0.05)	
faculties$_j$, Social Sciences		0.01		–0.00	–0.01	
		(0.02)		(0.01)	(0.02)	
K-P rk Wald F-stat			4.879	11.141	11.141	
Hansen J-stat			7.641	24.824	24.824	
(p-value)			0.365	0.255	0.255	
Panel B - STEM						32644
faculties$_j$, STEM	–0.09***	–0.11***	–0.08*	–0.05**	–0.09**	
	(0.03)	(0.03)	(0.04)	(0.02)	(0.04)	
faculties$_j$, Humanities		0.02		–0.03	–0.03	
		(0.02)		(0.02)	(0.02)	
faculties$_j$, Social Sciences		0.02		0.00	0.00	
		(0.02)		(0.01)	(0.02)	
K-P rk Wald F-stat			24.294	11.141	11.141	
Hansen J-stat			4.878	15.791	15.791	
(p-value)			0.675	0.781	0.781	
Panel C - Social Sciences						32644
faculties$_j$, Social sciences	–0.04*	–0.04	–0.16**	–0.07**	–0.12**	
	(0.02)	(0.03)	(0.07)	(0.03)	(0.05)	
faculties$_j$, STEM		0.02		–0.01	–0.03	
		(0.03)		(0.02)	(0.04)	
faculties$_j$, Humanities		–0.01		0.03	0.03	
		(0.04)		(0.02)	(0.03)	
K-P rk Wald F-stat			23.301	11.141	11.141	
Hansen J-stat			2.790	20.361	20.361	
(p-value)			0.904	0.498	0.498	

Notes:. Baseline pairwise estimates as in Table 5, Panel B, Column [3]. OLS FE estimates in Columns [1] and [2]. IV FE estimates in Column [3] with one endogenous regressor i.e. the no. of faculties in the respective discipline (Humanities in Panel A, STEM in Panel B, Social Sciences in Panel C), in the neighbouring province. In Column [4] IV FE estimates with three endogenous regressors i.e. the no. of faculties in Humanities, STEM and Social Sciences in the neighbouring province. The specification in Column [5] is the same as in Column [4], but regressors are standardised to have zero mean and unity standard deviation. In IV estimates, the instruments are interactions of initial conditions (total no. of faculties in each discipline in 1861) with a battery of dummies for higher education reforms in Italy. See Table B-3 for the first stage estimates. All specifications include provincial pair fixed effects, region-by-year fixed effects, the usual set of provincial controls. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

OLS FE and IV FE estimates, where the explanatory variable is the neighbour's HE supply in the same field of study. In Columns [2] and [4] we include neighbour's HE supply in the other two fields. To ease interpretation, Column [5] reports the same estimates of Column [4] with standardised coefficients.

Results support the view that HE supply in neighbouring provinces has a negative effect on the local supply within the same field of study. This means that HE services are substitutes within the same field of study. Conversely, there is not evidence of effects between fields of study, which suggests that e.g. a STEM faculty is not a close substitute of a faculty in Humanities or Social Sciences.

4.2.2 Demand for university education

In Table 7 we refine the analysis to account for time varying factors related to demand for university education at the province level.

In Panel A, we report the results from our benchmark pairwise specification (Table 5, Panel B, Column [3]). In Panel B, we show that our estimates are not altered when we exclude the 14 provinces hosting an Italian metropolitan city.[20] This suggests that our results are not driven by increases in demand for HE due to urbanisation effects. Changes in the size and composition of population may also matter. In Panel C, we show that results persist once we include as a control the total population (in log).[21] In Panel D, we include the population share in the $0-14$ cohort, and the population share with tertiary education. We were able to recollect this information only from 1951 onwards, and not for all provinces. This produces a substantial loss of observations, which slightly reduces the precision of the estimated coefficents, but leaves results unaffected. Demand for HE may aso follow the expansion of the industrial sector and labour market participation during the 20th century. In Panel E we account for that, and include as controls the participation rate and the population share active in the industry sector. Our results are robust to the inclusion of these controls too.

Finally, in Panel F we perform a placebo exercise to check whether our results truly capture neighbourhood effects. We impose a non-sense "alphabetical contiguity" relationship, and define provinces as neighbours if their name starts with the same letter of the alphabet, regardless of their actual geographical location (e.g. Alessandria is coded as neighbour of

[20]These are identified by the Italian Constitution: Bari, Bologna, Catania, Firenze, Genova, Messina, Milano, Napoli, Palermo, Reggio Calabria, Roma, Torino and Verona.

[21]Notice that population data are drawn from the Italian Census data, which occurred about once every ten years during the period 1861-2011. We assigned each population-by-province data point to the successive years, until a new wave of census data is available.

Table 7: Neighbourhood effects: local demand controls

	[1] OLS FE	[2] IV FE	[3] obs.
Panel A - Baseline specification			35060
total no. faculties in *j*	–0.05*	–0.12***	
	(0.02)	(0.04)	
K-P rk Wald F-stat		22.231	
Hansen J-stat		3.620	
p-value		0.822	
Panel B - Drop metropolitan cities			22814
total no. faculties in *j*	–0.11**	–0.22***	
	(0.04)	(0.07)	
K-P rk Wald F-stat		37.514	
Hansen J-stat		7.139	
p-value		0.415	
Panel C - Control for population size			34912
total no. faculties in *j*	–0.04	–0.12***	
	(0.03)	(0.04)	
K-P rk Wald F-stat		20.689	
Hansen J-stat		3.328	
p-value		0.853	
Panel D - Control for share of 0-14 years old and with higher education			11442
total no. faculties in *j*	–0.06**	–0.12*	
	(0.03)	(0.06)	
K-P rk Wald F-stat		31.842	
Hansen J-stat		2.371	
p-value		0.796	
Panel E - Control for participation and size of the industry sector			34912
total no. faculties in *j*	–0.05*	–0.12***	
	(0.02)	(0.04)	
K-P rk Wald F-stat		22.759	
Hansen J-stat		3.779	
p-value		0.805	
Panel F - Placebo: "alphabetical" neighbours			48337
total no. faculties in *j*	0.009	0.063	
	(0.020)	(0.061)	
K-P rk Wald F-stat		76.556	
Hansen J-stat		8.124	
p-value		0.322	

Notes: In Panel A baseline pairwise estimates as in Table 5, Panel B, column [3]. In Panel B, provinces with metropolitan cities (Bari, Bologna, Cagliari, Catania, Firenze, Genova, Messina, Milano, Napoli, Palermo, Reggio Calabria, Roma, Torino, Verona) are dropped from the sample. In Panel C, the total population is included in the set of controls. In Panel D, the share of population belonging to the 0-14 cohort and the share of population with higher education are included among the controls (available only for period 1951-2010). In Panel E, the share of active people in the industry sector, and the participation rate are included among the controls. In Panel F, neighbours are defined as provinces whose name starts with the same letter of the alphabet. All specifications include provincial pair fixed effects, region-by-year fixed effects, and the usual set of provincial controls. In IV estimates, the instruments are interactions of initial conditions with higher education reforms. The full set of coefficients is in Table B-4. Standard errors clustered at the province level. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Agrigento, despite being over 1000 Kms aparts). The estimates show that the negative coefficient of the number of faculties in j now disappears. This reassures us that the negative coefficient estimated in our main analysis truly relates to geographical proximity.

4.2.3 The spatial reach of neighbourhood effects

Up to now neighbours are all provinces j that share a border with local province i. Still, the HE supply of the province i may be influenced even by provinces that do not share a border with it, but are close enough in terms of distance. We used available Google Maps applications to compute linear distance, travel distance and travel time between province capitals (see Appendix A.2 for details). Using this information, we consider two alternative definitions of neighbourhood, which do not rely on sharing borders.

In Table 8 we investigate the "spatial reach" of neighbourhood effects. We consider a province j is a neighbour of province i as long as the linear distance $d_{i,j} < D$, where D is a chosen bandwith for neighbourhood effects (see Parchet, 2018). In practice, D is the treshold up to which HE supply in a province j is supposed to affect the local province i. We consider alternative specifications with bandwiths $D = 90, 180, 270, 360$ Km. Results in Columns [1] to [5] suggest that neighbourhood effects are concentrated within a spatial reach of 90 linear kilometres. Negative coefficients appear also at higher distances, but much smaller in size and generally non statistically significant. Any evidence of neighbourhood effects disappears for bandwiths that exceed 270 linear kilometers. In Table B-5 in the Appendix we define $d_{i,j}$ in terms of travel distance and travel time. We find that the spatial reach is at a bandwith of 120 kilometres travel distance, and 80 minutes of travel time. Any evidence of neighbourhood effects disappear for travels beyond 360 kilometers, and exceeding 3 hours.

In Table B-6 we feature a gravity model. In Panel A we consider a broader definition of neighbourhood where each province i has all the other Italian provinces $j \neq i$ as neighbours. We weight the number of faculties of each neighbour j ($F_{i,j}$ in equation (2)) by the inverse of the squared linear distance $d_{i,j}$ (i.e. $d_{i,j}^{-2}$). In Panel B we combine the gravity and contiguous borders approaches. For each province i, we consider only N_i contiguous provinces, and apply the inverse squared distance weight only to them. Differently to equation (2) the number of faculties $F_{i,j}$ is now weighted by $d_{i,j}^{-2}$. In a similar way, in Panel C we apply the gravity approach only to provinces within the spatial reach of 90Km. These three alternative weighting schemes deliver the usual results.

Table 8: Neighbourhood effects: spatial reach with linear distance matrix (in Km)

	[1] within 90 Km		[2] between 90 and 180 Km		[3] between 180 and 270 Km		[5] between 270 and 360 Km	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.039**	–0.095**	–0.045***	0.003	0.003	–0.014	–0.013	0.001
	(0.018)	(0.039)	(0.014)	(0.017)	(0.007)	(0.010)	(0.011)	(0.010)
Observations	43500	43500	88512	88512	99184	99184	77114	77114
K-P rk Wald F-stat		45.850		149.615		167.054		85.479
Hansen J-stat		9.190		4.349		7.142		10.233
p-value		0.239		0.739		0.414		0.176

Notes:. Baseline pairwise estimates. In IV estimates, the total no. of faculties in province j is instrumented by the initial conditions interacted by higher education reforms in Italy. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table 9: Heterogeneous neighbourhood effects

Panel A - Pre-WWII vs. post-WWII period				
	[1] pre-war		[2] post-war	
	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.03	–0.11	–0.04*	–0.10**
	(0.02)	(0.09)	(0.02)	(0.05)
Observations	17283	17283	14330	14330
K-P rk Wald F-stat		32.639		30.752
Hansen J-stat		–		2.637
p-value		–		0.756
Panel B - North vs. Centre-South				
	[1] North		[2] Centre-South	
	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.05	–0.14**	–0.04	–0.09**
	(0.03)	(0.06)	(0.03)	(0.04)
Observations	17785	17785	17275	17275
K-P rk Wald F-stat		19.167		39.900
Hansen J-stat		4.948		6.881
p-value		0.666		0.441
Panel C - Intra-regional vs. inter-regional competition				
	[1] intra-regional		[2] inter-regional	
	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.11**	–0.18***	0.03	–0.06
	(0.04)	(0.06)	(0.04)	(0.07)
Observations	20234	20234	14687	14687
K-P rk Wald F-stat		21.651		12.205
Hansen J-stat		5.331		1.947
p-value		0.620		0.963

Notes: Baseline pairwise estimates. In Panel A, pre-WWII and post-WWII periods are defined as before 1936 and after 1950, respectively. In Panel B, North regions belong to NUTS1 "North-East and "North-West", while Centre-South regions belong to NUTS1 "Centre", "South" and "Islands". In Panel C, intra-regional competition is between provinces in the same NUTS2 region, while inter-regional competition is between provinces belonging to different NUTS2 regions. In IV estimates, the instruments are interactions of initial conditions (total no. of faculties in 1861) with higher education reforms in Italy in each sub-period. First stage estimates available upon request. All specifications include provincial pair fixed effects, region-by-year fixed effects, and the usual set of provincial controls. Standard errors clustered at the province level. Significance levels: $*$: 10% $**$: 5% $***$: 1%

4.2.4 Heterogeneity and sensitivity analyses

In Table 9 we report four heterogeneity exercises. First, we divide the sample into two periods across World War II (WWII). A pre-war period is defined as before year 1936, while post-war as after year 1950 (Panel A). Results hold for both periods, although the negative coefficient is less precisely estimated in the pre-war period. Second, we split our sample between Northern regions, and Centre-Southern ones to capture long-lasting differences in development of HE system within Italy (Panel B). Our main result is confirmed in both macro-regions. Third, in Panel C we analyse heterogeneous interactions between provinces that belong to the same region, and provinces that belong to different regions. Interestingly enough, neighbourhood effects are mostly concentrated within the same region. This suggests that substitutability between faculties is lower when these are located in different regions, even though they are in neighbouring provinces.

In the Appendix we present further sensitivity checks. In the main analysis, the geographical units of observation are the provinces already existing at the onset of Italian history.[22] However, the creation of "new" provinces during 150 years changed their borders, and in many cases reduced their territories. In Table B-7 , Column [1] we define neighbourhood relationships on the basis of borders and territories of pre-unitarian provinces, which we maintain constant during Italian history. In doing so, we assign all faculties set up in a new province to the territory of the corresponding pre-unitarian one.[23] In Column [2] we assign to pre-unitarian provinces their 2010 borders and territories. In Column [3] we define pre-unitarian provinces all administrative units that existed in 2010 at their 2010 borders. In all cases, we maintain these definitions constant over Italian history. Our results are again confirmed alongside size and significance of the estimated coefficients (first stages are available upon request).

In Table B-8, we adopt alternative empirical strategies. In Column [1] we perform a robustness check in the spirit of De Giorgi et al. (2010), and include in the set of instruments the 2^{nd} degree spatial lag of the HE supply of the local province. The identifying assumption is that all provinces z that share a border with province j, but not with province i, are valid instruments to identify the impact of HE supply of province j on local supply in i. Our main results are preserved, however the Hansen J-test rejects the exogeneity of the instruments. In

[22] Thus, in the main analysis we excluded the faculties set up on former territories of pre-unitarian provinces that later became part of new ones. To make some examples, we exclude the faculties set up in the newborn province of Pescara (1927) on the former territory of the pre-unitarian province of Chieti. Similarly, we do not consider HE supply set up in the province of Taranto (funded in 1951), which belonged to the pre-unitarian province of Lecce at the onset of Italian state.

[23] To recall our previous examples, we assign faculties of the new provinces of Pescara and Lecce to the old pre-unitarian provinces of Chieti and Lecce, respectively.

Column [2] we concentrate on the decade 1966-1976 only. In this way, we focus on an "event study" that uses only the major liberalisation entailed by the 1969 and 1973 reforms.[24] The drop in the number of observations reduces the precision of the estimates, however our main results are not altered. In Columns [3] and [4], we include region-by-year dummies of the neighbouring province, and its HE supply controls, respectively. Also in this case our results are confirmed. Results do not change in Column [5] either, as we consider a ten years lagged effect of the instrument on the supply of the neighbour in the first stage. Finally, our results hold in Column [6] too, as we consider contiguous provinces within a spatial reach of 90 Km.

5 Welfare analysis

In this section we evaluate the economic returns of HE supply in terms of value added per capita. In doing so, we also quantify the net economic externalities from HE provision, after accounting for the local displacement effect pointed out in the previous section.

5.1 Economic returns of HE supply

We start by estimating the following model that relates HE supply and economic performance:

$$ln(1 + Y_{it}) = \phi_1 F_{it-10} + \phi_2 F_{-it-10} + X_{it-10}\phi_3 + \varphi_i + \xi_{r(i),t} + \mu_{it}, \quad (3)$$

where $ln(1 + Y_{it})$ is the (natural log of) per capita value added (VA) in province i at time t. F_{it-10} is the total number of faculties in province i at time $t-10$. F_{-it-10} is the total number of faculties in the neighbourhood of province i at time $t-10$. X_{it-10} is a vector of province level controls, including the rate of population growth, the participation rate and the share of active population in the industry sector in province i at time $t-10$.[25] φ_i is a province FE, and $\xi_{r(i),t}$ is a region-by-year FE. Finally, μ_{it} is the error term.

Information on VA (as well as controls in vector X) come from the Italian census data, which are collected roughly every 10 years. This means that during the 150 years' sample period, we observe provinces at most 16 times, i.e $T = 16$ in our unbalanced panel. Our

[24]This exercise can also be viewed as an additional robustness check that our results are not determined by omitted time varying factors associated with overtime changes to territory and borders of provinces. In fact the number and borders of provinces remain constant during this decade, the only exception being the creation of the Province of Isernia in 1971.

[25]In their analysis of the HE determinants of the industrial revolution in Prussia, Becker et al. (2011) consider the share of population active in the industry sector as the main outcome variable. In this setting we deem it relevant as a control, as our time period is posterior to the industrial revolution.

main parameters of interest are ϕ_1 and ϕ_2: these measure the economic returns of one more faculty in province i and its neighbourhood, respectively.

Two endogeneity issues complicate the estimation of equation (3). First, omitted factors may motivate both an increase in VA per capita and the opening of a new faculty. Second, reverse causality going from economic performance to HE supply: richer and/or more productive provinces may express a larger (or smaller) demand for HE. Thus, the opening of a new faculty may result from this demand.

We mitigate reverse causality concerns by taking ten years lagged values of HE supply indicators in equation (3). More importantly, we implement the usual IV estimator, and use $Z_{it-10} = IC_i * R'_{t-10}$, $Z_{-it-10} = IC_{-i} * R'_{t-10}$ as instruments for F_{it-10} and F_{-it-10} in equation (3). As we exploit a ten years' variation, in some cases R'_t captures exposure to "reform packages" implemented during the decade starting on year t.[26] We already discussed extensively the exogeneity of initial conditions and the reforms. The additional identifying assumptions we need here is that, conditional on the large set of province and region-by-year fixed effects, instruments do not have a direct effect on the local VA per capita.

Table 10 reports estimates from various specifications of model (3). In Columns [1] and [2] we report OLS FE and IV FE results when we consider only local faculties. These results point to positive returns from HE supply, of very similar magnitudes in OLS FE and IV FE estimates. A concern with IV FE estimates in Column [2] is collinearity between instruments and the country-by-region dummies, due to the ten years' time variation. The first stage in Table B-9 confirms this suspect, as in our vector of reform packages only the first three have explanatory power in the first stage. In Column [3], we use only the relevant instruments i.e. $IC_i * R_{21}$, $IC_i * R_{31}$, and $IC_i * R_{61}$. This greatly mitigates the problem of collinearity.

In Columns [4] to [9] we take into account that faculties in the neighbourhood may produce direct externalities on local VA per capita. We include an externality effect, either from all the contiguous provinces (Columns [4], [6], and [8]), or from contiguous provinces within the spatial reach of 90 Km (Columns [5], [7] and [9]). As the F-statistic of the additional instruments is below the critical value of 10, in Columns [6] and [7] we report results by limited information maximum likelihood (LIML), which is median-unbiased in over-identified models. Also, in Columns [8] and [9] we include as instruments the 20 years lagged values of HE supply in the local province and neighbourhood, which increases the

[26] More precisely the dummy R_{21} covers the decade 1921/30, which includes only the L. 2102/1923. R_{31} covers the decade 1931/40, which includes the L. 1592/1933 and R_{61} covers the decade 1961/70 and includes the Law 910/1969. Conversely, R_{71} covers years 1971/80 and includes a package composed by both Laws 766/1973 and 382/1980. Similarly, R_{81} includes L. 168/1989 and Laws 245-341/1990. Finally R_{91} covers Laws 59-127/1997.

Table 10: Economic returns of HE supply and externalities

	[1] OLS	[2] IV FE	[3] IV FE	[4] IV FE	[5] IV FE	[6] IV FE LIML	[7] IV FE LIML	[8] IV FE	[9] IV FE
Faculties in i	0.0071***	0.0068*	0.0078**	0.0119***	0.0099***	0.0127***	0.0101***	0.0104***	0.0102***
	(0.0014)	(0.0035)	(0.0036)	(0.0038)	(0.0034)	(0.0044)	(0.0037)	(0.0018)	(0.0018)
Faculties in $-i$				0.0057**	0.0051**	0.0067*	0.0055**	0.0024**	0.0029***
				(0.0029)	(0.0023)	(0.0035)	(0.0026)	(0.0010)	(0.0011)
Observations	937	937	937	937	937	937	937	874	874
$-i$ within 90 Km	–	–	–	no	yes	no	yes	no	yes
Instruments	no	IC*R	IC*R	IC*R	IC*R	IC*R	IC*R	IC*R	IC*R, F_{t-20}
Reforms (R)	–	all	three	three	three	three	three	three	three
K-P rk Wald F-stat	–	12.659	11.801	3.011	8.872	3.011	8.872	49.439	69.857
Hansen J-stat	–	13.620	2.681	5.088	5.916	5.036	5.982	5.962	5.842
p-value Hansen	–	0.018	0.262	0.278	0.206	0.284	0.201	0.427	0.441

Notes: In all specifications the dependent variable is VA per capita in natural logarithmic terms. The total number of faculties in the province and in the neighbourhood are lagged 10 years. All specifications include as controls, growth in local population, the participation rate and the size of the industry sector. All specifications include province FE and region by year dummies. In specifications [3]-[9] the three reform packages in vector R are R_{21}, R_{31}, and R_{61} only. Standard errors clustered at the province level in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

power of instruments in the first stage.

Overall, estimated coefficients ϕ_1 and ϕ_2 in Columns [4]-[9] are positive and statistically significant. Taken at their face value, conservative estimates in Column [8] suggest that, on average, increasing HE supply by 10% in the province (i.e. by 0.25 faculty) raises local VA per capita by more than $0.26\%(= 0.25 * 0.0104)$ at the sample mean. This is in line with results from existing studies (see e.g. Valero and Van Reenen, 2018).[27]

5.2 Effects on welfare

We can now discuss the two opposite effects of HE supply in the neighbourhood on local economic welfare. Existing studies focus on the *positive externality* that HE supply of neighbours has on local VA per capita (see e.g. Aghion et al., 2009; Valero and Van Reenen, 2018). This is measured by ϕ_2 in equation (3). In Section 4 we have showed that HE supply of neighbours also reduces local supply, i.e. $b < 0$ in equation (2). Thus, ϕ_1 in equation (3) can also be interpreted as the opportunity cost of not opening one faculty in the province, due to competitive pressures from the neighbourhood. Results in Table 10 suggest this marginal cost may be larger than 1% of foregone VA per capita. It measures a *negative "displacement" effect* on local welfare, which the literature never pointed out.

The net effect of neighbours' HE supply on local economic welfare depends on the relative size of these two counterbalancing forces. To quantify the net externality, and identify the regional distribution of the welfare effects, we perform a simulation exercise. We use coefficients from equations (2) and (3) to predict: (i) the effect of HE supply on VA per capita of province i, and (ii) its counterfactual without neighbourhood effects. We obtain the value of the net externality as the difference between (i) and (ii).

For simplicity, we take the last year of our sample i.e. $t = 2010$. In the actual situation, (ln) VA per capita of province i depends both on local and neighbours' HE supply:

$$ln(1 + \widetilde{Y}_{i,t}) = \widehat{\phi_1} F_{i,t} + \widehat{\phi_2} F_{-i,t}, \tag{4}$$

where $F_{i,t}$, $F_{-i,t}$ is the observed HE supply of province i and its neighbourhood, and $\widehat{\phi_1}$, $\widehat{\phi_2}$ are their estimated effects on VA per capita, respectively (from Table 10, Column [8]).

In the absence of neighbourhood effects, province i would neither benefit from positive

[27] The corresponding figure by Valero and Van Reenen (2018) is 0.4% of regional GDP per capita. This is very close to ours despite of the fact they measure HE supply in university units (rather than faculty units), within NUTS2 regions (instead of NUTS3), at the cross-country level (rather than one single country). Valero and Van Reenen (2018) provide empirical evidence in favour of both the industry innovation and human capital accumulation channels being at work.

welfare externalities, nor suffer from the negative competition effect from its neighbours. Its log VA per capita in this scenario would be:

$$ln(1 + \widetilde{\widetilde{Y}}_{i,t}) = \widehat{\phi}_1 \widehat{F}_{i,t} = \widehat{\phi}_1 (F_{i,t} - \widehat{b} \sum_{j \neq i} F_{ij,t}) = \widehat{\phi}_1 (F_{i,t} - \widehat{b} F_{-it}), \quad (5)$$

where $\widehat{b} < 0$ is the neighbourhood effect predicted from equation (2) and $\widehat{F}_{i,t}$ measures the counterfactual HE supply of province i, in the absence of neighbourhood effects. This is higher than observed HE supply, due to the lack of competitive pressures from contiguous provinces that act as disincentives to local provision. The net externality W_i^N is the difference between (4) and (5):

$$W_i^N = ln(1 + \widetilde{Y}_{i,t}) - ln(1 + \widetilde{\widetilde{Y}}_{i,t}) = (\widehat{\phi}_2 + \widehat{\phi}_1 \widehat{b}) F_{-it}. \quad (6)$$

This is the sum between the positive direct welfare externalities $\widehat{\phi}_2 F_{-i,t}$ and the negative displacement externality $\widehat{\phi}_1 \widehat{b} F_{-it}$.

Table 11: Simulation exercise: summary of welfare effects

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
$\widehat{\phi_1 F_{i,t}}$	0.049	0.066	0	0.394	110
$\widehat{\phi_2 F_{-i,t}}$	0.049	0.034	0	0.153	110
$\widehat{\phi_1 b F_{-it}}$	-0.025	0.018	-0.079	0	110
$ln(1 + \widetilde{Y}_{i,t})$	0.098	0.072	0	0.428	110
$ln(1 + \widetilde{\widetilde{Y}}_{i,t})$	0.075	0.067	0	0.411	110
W_i^N	0.024	0.016	0	0.074	110
Y_i	2.31	0.56	1.33	3.49	107
$\widetilde{Y}_i = \widetilde{Y} = (e^{ln(1+\widetilde{Y}_i)} - 1)$	0.106	0.085	0	0.534	110
$\widetilde{\widetilde{Y}}_i = (e^{ln(1+\widetilde{\widetilde{Y}}_i)} - 1)$	0.08	0.078	0	0.509	110
$\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i = (e^{W^N} - 1)(\widetilde{\widetilde{Y}}_i + 1)$	0.026	0.019	0	0.083	110

Notes: Predicted effects in ln(1+VA) terms from equations (4)-(6) in the text. Values refer to 2010.

Table 11 summarises average predicted HE returns and its components (in ln(1+VA) terms) from equations (4)-(6) above. The value $ln(1 + \widetilde{Y}_{i,t}) = 0.098$ implies that HE supply predicts 4.4% of local VA per capita, on average.[28] $\widehat{\phi}_1 F_i = \widehat{\phi}_2 F_{-i} = 0.049$ features an equal contribution of local and neighbours' HE supply, which however does not take into account displacement forces. The net economic externality has to account for the opportunity cost of HE supply in the neighbourhood, in terms of returns from foregone local supply. This is

[28]In practice, we apply the transformation $\widetilde{Y} = (e^{ln(1+\widetilde{Y})} - 1) = (e^{0.098} - 1) = 0.106$. This is indeed the 4.4% of local VA per capita in 2010 where $\overline{Y} = 2.31$ (see Table 2).

measured by the difference $\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i$, which shows that net externalities explain only about 1.1% of local VA per capita, on average.[29] This implies that about three quarters of HE returns in province (equal to 3.3% of local VA per capita) are determined by local faculties, on average. This is also measured by $\widetilde{\widetilde{Y}}_i$.

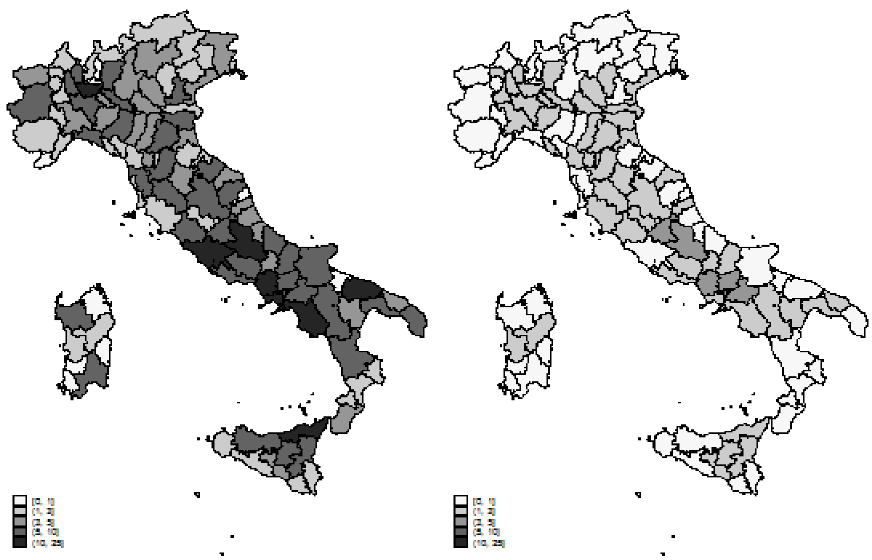
In Figure 4 we draw the cross-province distribution of predicted HE returns and net externalities. Panel (a) looks at the geographical distribution of observed returns, $\widetilde{Y}$. These tend to be negligible (less than 1% of local VA per capita; transparent grey shaded provinces) or small (between 1% and 3%, light grey shaded areas) in peripheral provinces that only benefit from faculties of a few small neighbours. Small provinces with local universities enjoy up to 5% of local VA per capita (grey shaded provinces). Returns are larger in Italian provinces that benefit of externalities from major Italian metropolitan areas (between 5% and 10%, intense grey shaded provinces). Large provinces such as Milano, Roma and Napoli benefit from agglomeration effects due to local university hubs that predict up to 25% of local per capita VA (dark grey shaded provinces).

Panel (b) shows the geographical distribution of the net externalities ($\widetilde{Y} - \widetilde{\widetilde{Y}}$). Everywhere these are non-negative, which means that positive economic effects are larger than negative displacement costs in all provinces. Cross-province figures confirm net externalities are generally not too large. In most border provinces (particularly in the North-East) they predict less than 1% of local VA per capita (transparent grey shaded provinces). Around most urban areas, they predict between 1% and 3% of local per capita VA (light grey shaded areas). In the neighbourhood of large HE agglomerations such as Roma and Napoli net externalities predict up to 5% of the local VA per capita (grey shaded provinces).

Overall, these results highlight sizeable local returns from HE supply, especially in areas that can benefit of the provision by major urban areas. They also suggest that caution is needed when assessing the magnitude of spillovers from the neighbourhood. Once we account for the economic cost associated with displacement effects, HE returns appear strongly localised. Disregarding these forces may severely overestimate the size of economic externalities from faculties in the neighbourhood.

[29] In fact $(\widetilde{Y} - \widetilde{\widetilde{Y}})/Y_i = 0.026/2.31 = 1.12$. Notice that the same net externality is also measured by W_N in ln(1+VA) terms in equation 6 and Table 11. In practice the difference $\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i$ is a transformation that provides an economically intuitive measure of W^N in equation (6).

Figure 4: Geographical distribution of predicted HE returns



(a) total returns, $\widetilde{Y}_i$ (b) net externalities, $(\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i)$

Notes: Ratios $\widetilde{Y}_i/Y_i$ and $(\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i)/Y_i$ in Panels (a),(b), respectively. Y_i is VA per capita of province i. All values refer to 2010. Information on Y_i is not available for provinces of Barletta, Carbonia-Iglesias, Fermo, Monza-Brianza, Medio-Campidano and Ogliastra. Detailed values by province are in Table B-10.

6 Conclusions

In this paper we used an own-built historical dataset for Italy with fine-grained province level information to analyse neighbourhood and welfare effects of HE supply. We exploited exogenous variation associated with the initial conditions of university faculties and national HE reforms, and showed that HE supply explains 4.4% of a province per capita value added, on average. *Prima facie* empirical evidence suggested that returns equally stem from local and neighbours' HE supply. However, once we accounted for displacement costs, we uncovered that three quarters of returns arise within the same province. We simulated the provincial distribution of HE returns, and showed that in 2010 university agglomerations explain up to 25% of local per capita VA in large Italian provinces.

These results seem to provide an economic rationale to the statement that local HE providers better match local development needs (OECD, 2008, 2014). According to this interpretation, the economic benefits of expanding the HE supply are to be considered inherently local, similar to the advantages of large plant openings. These may partly explain observed cross-regional differentials in human capital, productivity and income per capita (Gennaioli et al., 2013), particularly when resources (e.g. students, public and private investments) are scarce and/or mobility is low.

Our analysis can be extended in many directions. While we implicitly assumed HE institutions are homogeneous, it would be interesting to incorporate in the analysis some heterogeneity (e.g. in terms of quality of education provided). Further research is also needed to point out the exact mechanism(s) that determine aggregate HE returns, and establish whether it is human capital accumulation, and/or changes to industry composition and technologies, in the spirit of Ciccone and Peri (2006, 2011). Finally, notice that we do not carry over specific policy proposals regarding the territorial distribution of a country's HE supply. The choice between e.g. a relatively dispersed vs. agglomerated HE depends on underlying country and region-level parameters such as the alignment of objectives of local and national policymakers (Glaeser, 2010).

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Appendix A Data Appendix

Appendix A.1 HIU Register data

The register dataset on the History of Italian Universities (HIU) contains detailed and complete information on institutions providing higher education in Italy, disaggregated at the faculty level over the period 1861-2010. The register includes the following information:

- University name.
- Faculty name.
- 15 faculty field identifiers (Agricultural studies, Architecture, Chemical and Pharmaceutical studies, Economics and Statistics, Physical Education, Geo-Biological studies, Law, Engineering, Educational studies, Litery studies and Philosophy, Foreign Languages, Medicine, Political Sciences, Psycology, and Mathematical Sciences), which we aggregated into 7 teaching areas (Socio-Economic area, Physical Education, Law, Engineering and Architecture, Medicine, Sciences, and Humanities.) and 3 macro-areas of science (Social Sciences, STEM, Science, Technology, Engineering and Mathematics - STEM, and Humanities), according to the classification used by the Italian National Statistical Office.
- Year of establishment of the faculty. This is recorded as the year when the faculty is formally established as a provider of a higher education degree. Alongside with this basic information, we recorded other potentially important ancillary dates i.e. whether the faculty was built upon a pre-existing major of studies (e.g. belonging to an existing faculty), the year the faculty was formally recognised as a provider of University education, the date(s) when the faculty became part of a different university. Details over institutional developments that motivate these alternative definitions are available in the on-line Appendix.
- Address of the university.
- Address of the faculty.

The final version of the register includes 582 faculties and (in) 78 universities registered on the Italian territory at some point between 1861 and 2010.

About the 99% of faculties in our sample deliver standard BSc education. There are 5 faculties specialised in post-graduate education only (i.e. belonging to Universita' Normale di

Pisa, Universita' Europea di Roma, Universita' di Scienze Gastronomiche, and IMT Lucca), and 3 faculties that enroll foreign students only (i.e. belonging to Universita' per Stranieri di Siena, Perugia, and Reggio Calabria).

While they track very precisely the creation of new HE institutions during Italian history, as well as their change in status and governance, our data record only seven cases of effective faculty closures. Four engineering faculties were closed due the re-organisation of the Politechnic School of Milan, which in 2000 closed down its campuses in Como and Lecco and opened brand new faculties in the Milan area. The faculty of Chemical studies was shut down by the Ca Foscari University of Venice, in 1990 as well as the faculties of Environmental Sciences and Mathematical Sciences in Urbino in 2006. This may underestimate the actual closure HE education institutions. As a matter of fact, our sources do not allow to map closures as precisely as start-ups. However, none of our original sources mentions significant waves of closure of HE institutions during Italian history. (see on-line Appendix and Brizzi and Romano (2007) Vol.3 for details.).

Our data do not record changes in the exact address of each university and each faculty at each point in time i.e. do not record changes of address over time. The university address is identified by the address of the university dean, and the faculty address is the address of the faculty dean. Both are collected as for 2010.

Appendix A.2 Neighbourhood and distance matrices

We constructed two alternative local interaction matrices. The first one (1) is a simple contiguity matrix available from ISTAT. The second one (2) is a distance matrix, which contains information on (a) linear distance, (b) travel distance, and (c) travel time. We computed distances using the Google Maps API Geometry Library, and Google Maps Distance Matrix API, respectively.

1 Contiguity matrix. Each province i is matched to (the HIU indicators of) its neighbours, which we define as provinces j that share a border with province i. Notice that due to the process of provinces creation discussed above, the neighbours of each province i in most cases change over time. In practice, consider the example of province k, which is a neighbour of province i at time t. Imagine that at time $t+1$ a new province z is established, which covers the geographical territory of k that shares a border with i. Our data register this changes overtime so that until time t province k is recorded as being neighbour of province i, while starting from time $t+1$ k is no longer adiacent to i, while province z appears in the data, which shares a border with i.

2a Linear distance matrix. Each province i is matched to (the HIU indicators of) all other provinces $j \neq i$, and for each (i, j) couple, the linear distance is recorded between i and j. This is the distance in Km calculated "on-air", by drawing, and measuring the lenght of a straight line between the capitals of province i and province j (capoluoghi di provincia). Notice that, as long as the capitals of provinces do not change over time, the distance between provinces remains constant over our sample. In the case of provinces with multiple "capoluoghi", the largest capoluogo is considered as capital. However there are only two cases in Italy (Barletta-Andria-Trani, and Pesaro-Urbino).

2b Travel distance matrix. Each province i is matched to (the HIU indicators of) all other provinces $j \neq i$, and for each (i, j) couple, the travel distance is recorded between i and j. This is the lowest distance in Km that one needs to travel from/to i to/from province j, with whatever transport available (plane, car, train). Notice that these distances are recorded in 2016, so they take a cross-sectional picture of travel connections between italian provinces in that specific year i.e. they do not take into account the process of infrastructures building that has occurred during italian history. The same convention as in the case of linear distances applies to Barletta-Andria-Trani, and Pesaro-Urbino.

2c Travel time matrix. Each province i is matched to (the HIU indicators of) all other provinces $j \neq i$, and for each (i, j) couple, the travel time is recorded between i and j. This is the lowest time in minutes, that one needs to travel from/to i to/from province j, with whatever transport available (plane, car, train). Also travel time is recorded in 2016, so it does not take into account the process of infrastructures building and innovation that has occurred during Italian history. The usual convention as in the case of distances applies to Barletta-Andria-Trani, and Pesaro-Urbino.

Appendix A.3 Additional province level variables

We collected historical indicators on province level economic and social characteristics from Unioncamere (2011). Historical series were completed using the direct Census sources.

Total population: Population of residents in the province, all ages (Source: Unioncamere, 2011).

Total population in the 0-14 cohort: Population of residents aged 0-14 in the province (Source: Italian Census data, 1951-2010).

Higher education: Population with tertiary education as a percentage of total population in the province (Source: Italian Census data, 1951-2010).

Provincial VA per capita (worker): i.e. total provincial VA divided the total population (active population) of the province (Source: Unioncamere, 2011). Original historical series expressed in nominal terms (in lira, current values). Real figures were obtained by applying the VA deflator at constant 1911 prices, available from ISTAT.

Provincial participation rates: Active population, as a percentage of total population (Source: Unioncamere, 2011).

Share of active population in agriculture industry services: number of workers in agriculture industry services as a share of total workers (Source: Unioncamere, 2011).

Census data covers the period 1861-2010. The collection years are 1861, 1871, 1891, 1901, 1911, 1921, 1931, 1936, 1951, 1961, 1971, 1981, 1991, 2001, 2010. Census data are not available for 1881, so we retrieved them by linear interpolation.

Appendix B Additional Tables

Table B-1: Number of Faculties in Italy by field of study: 1870 and 2010

Faculty	1870	2010
Humanities	16	127
Education	1	34
Languages	1	24
Literature	12	54
Psychology	2	15
Scientific and Medical studies	51	186
Agriculture	9	37
Chemistry&Pharmacy	18	31
Geology&Biology	1	3
Scientific studies	15	48
Architecture	3	23
Engineering	5	44
Social Sciences	42	210
Medical studies	19	39
Economics&Statistics	1	68
Law	21	55
Socio-political studies	1	48

Notes: There are five faculty fields that first appeared in Italian universities after 1870 that are Education (1876), Foreign Languages (1954), Geology and Biology (1993) and Psychology (1971).

Table B-2: Omitted neighbourhood variables and IV: full set of coefficients

	[1] baseline sample		[3] pre-unitarian provinces		[4] pre-unitarian prov. (lagged 10 y.)	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
Panel A - Average neighbour approach						
total no. faculties in $-i$	–0.48***	–1.14***	–0.09	–1.08**	–0.11	–0.94*
	(0.14)	(0.39)	(0.08)	(0.49)	(0.10)	(0.50)
no. of universities	1.48***	1.36**	1.82***	2.00***	1.62**	2.11***
	(0.55)	(0.57)	(0.64)	(0.63)	(0.61)	(0.55)
no. of A-level universities	1.06***	0.86**	0.87**	0.31	0.95***	0.59
	(0.34)	(0.34)	(0.34)	(0.41)	(0.31)	(0.39)
no. of private universities	2.38***	2.20***	1.93***	1.41**	2.28***	1.71**
	(0.57)	(0.56)	(0.53)	(0.57)	(0.71)	(0.65)
Panel B - Pairwise approach						
total no. faculties in j	–0.08***	–0.16***	–0.04**	–0.13**	–0.05*	–0.12***
	(0.03)	(0.05)	(0.02)	(0.06)	(0.02)	(0.04)
no. of universities	2.17***	2.20***	2.34***	2.48***	2.17***	2.37***
	(0.52)	(0.49)	(0.56)	(0.49)	(0.54)	(0.45)
no. of A-level universities	0.65**	0.64***	0.48*	0.46**	0.56**	0.57**
	(0.27)	(0.24)	(0.26)	(0.21)	(0.26)	(0.22)
no. of private universities	1.95***	1.79***	1.47***	1.29***	1.82***	1.77***
	(0.54)	(0.50)	(0.45)	(0.38)	(0.59)	(0.54)

Notes:. Full set of coefficients refers to OLS FE and IV FE estimates reported in Table 5. All specifications include province fixed effects (Panel A), provincial pair fixed effects (Panel B), and region-by-year fixed effects. In IV estimates, the instruments are interactions of initial conditions with higher education reforms, as reported in table 4. Standard errors clustered at the province level. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-3: Neighbourhood effects across and within field of study: first stage

	Humanities (HH)		Stem (ST)		Social Sciences (SS)	
(IC_j in HH)*(L. 2102/1923)	0.34***	–0.18***		0.09		1.05***
	(0.11)	(0.06)		(0.08)		(0.08)
(IC_j in HH)*(L. 1592/1933)	0.08	–0.23***		0.26***		0.41***
	(0.06)	(0.06)		(0.07)		(0.07)
(IC_j in HH)*(L. 910/1969)	0.16**	–0.22**		0.49***		0.06
	(0.07)	(0.10)		(0.04)		(0.11)
(IC_j in HH)*(L. 766/1973)	0.04	–0.12**		0.12***		0.30***
	(0.03)	(0.05)		(0.04)		(0.10)
(IC_j in HH)*(L. 382/1980)	0.01	0.03		–0.05		0.01
	(0.02)	(0.02)		(0.04)		(0.05)
(IC_j in HH)*(L. 168/1989)	–0.05**	0.06**		–0.34***		0.11**
	(0.02)	(0.03)		(0.06)		(0.04)
(IC_j in HH)*(L. 245-341/1990)	0.41***	0.40***		–0.53***		0.14**
	(0.11)	(0.09)		(0.08)		(0.07)
(IC_j in HH)*(L. 59/1997)	0.58***	0.36***		–0.26***		0.13
	(0.14)	(0.11)		(0.08)		(0.13)
(IC_j in ST)*(L. 2102/1923)		0.14***		0.04	0.15***	–0.23***
		(0.02)		(0.04)	(0.04)	(0.04)
(IC_j in ST)*(L. 1592/1933)		–0.03		–0.10**	0.15***	0.09**
		(0.02)		(0.05)	(0.02)	(0.04)
(IC_j in ST)*(L. 910/1969)		–0.05		–0.18***	0.22***	0.15***
		(0.04)		(0.03)	(0.02)	(0.04)
(IC_j in ST)*(L. 766/1973)		–0.12***		–0.04*	0.12**	0.23***
		(0.03)		(0.02)	(0.05)	(0.07)
(IC_j in ST)*(L. 382/1980)		–0.01		–0.04	0.00	0.04**
		(0.01)		(0.02)	(0.02)	(0.02)
(IC_j in ST)*(L. 168/1989)		–0.02		0.05**	0.02	0.00
		(0.01)		(0.02)	(0.02)	(0.02)
(IC_j in ST)*(L. 245-341/1990)		0.11***		–0.02	0.05	–0.11***
		(0.03)		(0.04)	(0.03)	(0.03)
(IC_j in ST)*(L. 59/1997)		0.17***		–0.03	0.07	–0.12**
		(0.04)		(0.03)	(0.05)	(0.06)
(IC_j in SS)*(L. 2102/1923)		–0.17***	0.10***	0.02		0.11***
		(0.03)	(0.03)	(0.03)		(0.04)
(IC_j in SS)*(L. 1592/1933)		0.09***	0.11***	0.10**		–0.09**
		(0.03)	(0.03)	(0.04)		(0.04)
(IC_j in SS)*(L. 910/1969)		0.18***	0.09***	0.03		–0.00
		(0.06)	(0.02)	(0.04)		(0.06)
(IC_j in SS)*(L. 766/1973)		0.17***	0.02	0.01		–0.29***
		(0.03)	(0.01)	(0.03)		(0.07)
(IC_j in SS)*(L. 382/1980)		–0.00	0.03	0.08***		–0.06**
		(0.01)	(0.02)	(0.02)		(0.03)
(IC_j in SS)*(L. 168/1989)		–0.06***	0.09***	0.14***		–0.01
		(0.02)	(0.03)	(0.04)		(0.02)
(IC_j in SS)*(L. 245-341/1990)		–0.22***	0.16***	0.29***		0.09**
		(0.05)	(0.03)	(0.06)		(0.04)
(IC_j in SS)*(L. 59/1997)		–0.15***	–0.00	0.04		0.09
		(0.05)	(0.02)	(0.04)		(0.07)
R sq.	0.82	0.89	0.96	0.97	0.87	0.93
N	32644	32644	32644	32644	32644	32644

Notes:. First stage of IV FE estimates reported in Table 6. All specifications include provincial pair fixed effects, region-by-year fixed effects, and the usual set of provincial controls. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-4: Neighbourhood effects: controls for local demand

	[1] OLS FE	[2] IV FE	[3] Obs.
Panel A - Baseline specification			35060
total no. faculties in j	–0.05*	–0.12***	
	(0.02)	(0.04)	
no. of universities	2.22***	2.42***	
	(0.54)	(0.45)	
no. of private universities	1.78***	1.72***	
	(0.59)	(0.54)	
no. of elite universities	0.55**	0.56**	
	(0.27)	(0.23)	
Panel B - Drop metropolitan cities			22814
tot. no. faculties in j	–0.11**	–0.22***	
	(0.04)	(0.07)	
no. of universities	1.93***	2.14***	
	(0.50)	(0.40)	
no. of private universities	0.27	0.16	
	(0.52)	(0.43)	
no. of elite universities	0.77***	0.71***	
	(0.27)	(0.23)	
Panel C - Control for population size			34912
total no. faculties in j	–0.04	–0.12***	
	(0.02)	(0.04)	
no. of universities	2.01***	2.24***	
	(0.60)	(0.50)	
no. of private universities	1.68***	1.74***	
	(0.60)	(0.55)	
no. of elite universities	0.47*	0.54**	
	(0.27)	(0.23)	
total population (log)	1.37*	0.75	
	(0.76)	(0.68)	
Panel D - Control for share of active in industry sector			34912
total no. faculties in j	–0.05*	–0.12***	
	(0.02)	(0.04)	
no. of universities	2.17***	2.42***	
	(0.55)	(0.45)	
no. of private universities	1.82***	1.72***	
	(0.58)	(0.53)	
no. of elite universities	0.55**	0.55**	
	(0.27)	(0.23)	
share of active in the industry sector	–0.01	–0.01	
	(0.01)	(0.01)	
participation rate	0.01	0.01	
	(0.01)	(0.01)	
Panel E - Control for share of 0-14 years old and share tertiary educated			11442
total no. faculties in j	–0.06**	–0.12*	
	(0.03)	(0.06)	
no. of universities	1.98***	2.04***	
	(0.58)	(0.55)	
no. of private universities	1.49***	1.39***	
	(0.53)	(0.50)	
0-14 cohort shaare	–0.02	–0.02	
	(0.07)	(0.07)	
share with tertiary education	1.79**	1.94**	
	(0.81)	(0.74)	
Panel F - Placebo: "alphabetical" neighbours			48337
total no. faculties in j	0.009	0.063	
	(0.020)	(0.061)	
no. of universities	1.750***	1.796***	
	(0.587)	(0.554)	
no. of elite universities	0.986***	1.055***	
	(0.284)	(0.261)	
no. of private universities	2.421***	2.224***	
	(0.626)	(0.600)	

Notes: Full set of coefficients refers to OLS FE and IV FE estimates reported in Table 7. All specifications include provincial pair fixed effects, and region-by-year fixed effects. In IV estimates, the instruments are interactions of initial conditions with higher education reforms. Standard errors clustered at the province level. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-5: Neighbourhood effects: distance and time matrices

Panel A - Travel distance (Km)								
	[1] within 90 Km		[2] between 90 and 180 Km		[3] between 180 and 270 Km		[4] between 270 and 360 Km	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.046**	–0.136***	–0.019	0.021	–0.016	–0.024*	0.009	–0.002
	(0.018)	(0.044)	(0.014)	(0.014)	(0.012)	(0.013)	(0.011)	(0.007)
Observations	40069	40069	91090	91090	100647	100647	78450	78450
K-P rk Wald F-stat		37.398		151.815		155.445		75.294
K-P rk LM-stat		42.040		52.940		49.915		55.750
p-value		0.000		0.000		0.000		0.000
Hansen J-stat		9.525		8.164		6.271		6.867
p-value		0.217		0.318		0.508		0.443
Panel B - Travel time (minutes)								
	[1] within 80 minutes		[2] between 80 and 160 min.		[3] between 160 and 240 min.		[4] between 240 and 360 min.	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.090***	–0.162***	–0.014	–0.003	–0.003	–0.018	0.017	0.007
	(0.028)	(0.045)	(0.013)	(0.014)	(0.008)	(0.012)	(0.011)	(0.007)
Observations	29403	29403	102981	102981	115585	115585	84469	84469
K-P rk Wald F-stat		28.582		193.543		178.643		73.552
K-P rk LM-stat		38.753		53.891		52.401		53.702
p-value		0.000		0.000		0.000		0.000
Hansen J-stat		9.270		9.724		5.520		6.045
p-value		0.234		0.205		0.597		0.534

Notes:. Specification as in Table 5 column [3] with pre-unitarian provinces during the entire period and 10 years lags of regressor and controls. In IV estimates, the total no. of faculties in province j is instrumented by the initial conditions (i.e. number of majors in j in 1861) interacted by a battery of dummies for higher education reforms in Italy. All specifications include provincial pair fixed effects, region-by-year fixed effects, and the usual set of provincial controls. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-6: Distance weighted neighbourhood effects on HE supply

	[1] OLS FE	[2] IV FE	[3] Obs.
Panel A - All provinces			626234
total no. faculties in j	–0.06***	–0.13***	
	(0.02)	(0.04)	
K-P rk Wald F-stat		89.197	
K-P rk LM-stat		51.225	
p-value		0.000	
Hansen J-stat		9.863	
p-value		0.196	
Panel B - Contiguous provinces			35073
total no. faculties in j	–0.10**	–0.29***	
	(0.05)	(0.08)	
K-P rk Wald F-stat		22.893	
K-P rk LM-stat		27.588	
p-value		0.001	
Hansen J-stat		7.803	
p-value		0.350	
Panel C - Provinces within 90 Km			43427
total no. faculties in j	–0.08**	–0.22***	
	(0.04)	(0.06)	
K-P rk Wald F-stat		41.408	
K-P rk LM-stat		36.779	
p-value		0.000	
Hansen J-stat		8.951	
p-value		0.256	

Notes: Weighted neighbourhood effects by the inverse of squared linear distance $(1/d_{ij}^2)$. All specifications include provincial pair fixed effects, and region-by-year fixed effects. In IV estimates, the instruments are interactions of initial conditions with higher education reforms. Standard errors clustered at the province level. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-7: Neighbourhood effects: alternative definitions of pre-unitarian provinces

	[1] existing in 1870, borders at 1870		[2] existing in 1870, borders in 2010		[3] existing in 2010 borders in 2010	
	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
total no. faculties in j	–0.01	–0.09**	–0.02	–0.07*	–0.08***	–0.09***
	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)	(0.03)
Observations	42813	42813	42813	42813	68410	68410
K-P rk Wald F-stat		36.130		41.221		48.375
K-P rk LM-stat		42.550		44.206		71.220
p-value		0.000		0.000		0.000
Hansen J-stat		6.046		6.797		10.327
p-value		0.534		0.450		0.171

Notes: Baseline pairwise estimates. Borders and territory of pre-unitarian provinces are maintained constant over the entire period $1870 - 2011$. In column [1] pre-unitarian provinces are defined by borders and territory at 1870 i.e. the HE supply of the territory of provinces created during Italian history is reassigned to the pre-unitarian province from which the new provinces have been created. In column [2] pre-unitarian provinces are defined by borders and territory in 2010. In column [3] pre-unitarian provinces are defined as administrative units in 2010 at their 2010 borders and territories. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-8: Sensitivity analysis: alternative empirical strategies

	[1] IV FE	[2] IV FE	[3] IV FE	[4] IV FE	[5] IV FE	[6] IV FE
total no. faculties in j	–0.12**	–0.19*	–0.14***	–0.13***	–0.16***	–0.12**
	(0.06)	(0.11)	(0.05)	(0.05)	(0.05)	(0.05)
K-P rk Wald F-stat	29.118	27.529	28.608	58.178	23.230	63.414
K-P rk LM-stat	39.760	23.703	42.723	44.423	41.329	58.088
p-vale KP	0.000	0.000	0.000	0.000	0.000	0.000
Hansen J-stat	17.212	0.014	2.540	3.823	4.908	7.434
p-value Hansen	0.028	0.906	0.924	0.800	0.427	0.385
1st Stage Results						
no. faculties in 2^{nd} degree neighbour	–0.01*					
	(0.00)					
(IC_j)*(L. 2102/1923)	0.19***		0.27***	0.15***	0.26***	0.13***
	(0.05)		(0.04)	(0.04)	(0.04)	(0.04)
(IC_j)*(L. 1592/1933)	0.14***		0.16***	0.16***	0.17***	0.11***
	(0.02)		(0.02)	(0.02)	(0.02)	(0.03)
(IC_j)*(L. 910/1969)	0.22***	0.10***	0.23***	0.24***	0.19***	0.20***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
(IC_j)*(L. 766/1973)	0.06***	0.07***	0.08***	0.06***	0.01	0.05***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
(IC_j)*(L. 382/1980)	–0.03**		0.00	0.01	0.17***	0.06**
	(0.01)		(0.01)	(0.02)	(0.04)	(0.02)
(IC_j)*(L. 168/1989)	0.02*		0.01	0.03***	0.17***	0.04***
	(0.01)		(0.01)	(0.01)	(0.05)	(0.01)
(IC_j)*(L. 245/1990)	0.10***		0.11***	0.13***		0.22***
	(0.02)		(0.03)	(0.03)		(0.05)
(IC_j)*(L. 59/1997)	0.08***		0.10***	0.14***		0.20***
	(0.03)		(0.03)	(0.03)		(0.03)
R sq.	0.93	0.99	0.94	0.96	0.93	0.97
Observations	109817	2653	34904	35060	32210	35328

Notes: Baseline pairwise estimates. All specifications include provincial pair fixed effects, region-by-year fixed effects, and the usual set of provincial controls. In column [1], the set of instruments includes the 2^{nd} degree spatial lag of the local province. Regressions in column [2] cover the sub-period 1966-1976 only. In column [3] region-by-year FE for the region of the neighbouring province are included. In column [4], we include the number of universities (total, A-level, private) of the neighbouring province as additional controls. In column [5], we lag instruments ten years relative to the dependent variable in the first stage. In column [6] we define neighbours as provinces that have a shared border, within the spatial reach of 90 Km. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-9: Economic returns of HE supply (1st stage)

	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE	OLS FE	IV FE
$IC_i * R_{21/30}$	0.2819***	0.2816***	0.2988***	0.2986***	0.2988***	0.2986***	0.0593	0.0610
	(0.0652)	(0.0650)	(0.0732)	(0.0719)	(0.0732)	(0.0719)	(0.0499)	(0.0503)
$IC_i * R_{31/36}$	0.1842***	0.1844***	0.2035***	0.1931***	0.2035***	0.1931***	–0.0971	–0.1001
	(0.0548)	(0.0546)	(0.0545)	(0.0537)	(0.0545)	(0.0537)	(0.0956)	(0.0924)
$IC_i * R_{61/70}$	0.1555***	0.2758***	0.2742***	0.2861***	0.2742***	0.2861***	–0.0116	–0.0036
	(0.0427)	(0.0921)	(0.0997)	(0.0976)	(0.0997)	(0.0976)	(0.0772)	(0.0757)
$IC_i * R_{71/80}$	0.0277							
	(0.0425)							
$IC_i * R_{81/90}$	0.2047							
	(0.1340)							
$IC_i * R_{91/00}$	–0.0096							
	(0.0393)							
F_{t-20}							1.1100***	1.1095***
							(0.1348)	(0.1337)
Observations	937	937	937	937	937	937	874	874

Notes: First stage of IV FE estimates reported in Table 10. All specifications include province fixed effects and region-by-year fixed effects, population growth, participation rate and size of the industry sector. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-10: Welfare analysis of HE supply.

Province	$F_{-i,2010}$	$F_{i,2010}$	$\widehat{F}_{i,2010}$	$\widetilde{Y}_{i,2010}$	$\widetilde{\widetilde{Y}}_{i,2010}$	$\widetilde{Y}_{i,2010} - \widetilde{\widetilde{Y}}_{i,2010}$
Agrigento	11.00	0.00	1.34	1.83	0.94	0.89
Alessandria	36.00	3.00	7.37	4.83	3.05	1.78
Ancona	29.00	5.00	8.52	4.77	3.39	1.38
Aosta	15.00	5.00	6.82	3.26	2.59	0.67
Ascoli Piceno	24.00	1.00	3.91	3.23	1.88	1.35
Aquila	51.00	7.00	13.19	10.96	7.40	3.56
Arezzo	42.00	1.00	6.10	4.55	2.50	2.05
Asti	17.00	0.00	2.06	1.68	0.86	0.82
Avellino	42.00	0.00	5.10	6.59	3.33	3.26
Bari	5.00	16.00	16.61	11.81	11.39	0.42
Bergamo	39.00	6.00	10.73	5.54	3.84	1.70
Biella	15.00	0.00	1.82	1.43	0.74	0.70
Belluno	18.00	0.00	2.18	1.58	0.81	0.77
Benevento	37.00	4.00	8.49	8.99	5.89	3.09
Bologna	26.00	15.00	18.16	7.64	6.47	1.16
Brindisi	21.00	2.00	4.55	4.93	3.20	1.73
Brescia	16.00	6.00	7.94	3.70	2.98	0.71
Bolzano	6.00	3.00	3.73	1.42	1.20	0.22
Cagliari	0.00	11.00	11.00	5.77	5.77	0.00
Campobasso	20.00	6.00	8.43	5.97	4.65	1.32
Caserta	32.00	10.00	13.88	13.81	10.75	3.06
Chieti	13.00	7.00	8.58	5.58	4.73	0.85
Caltanissetta	22.00	0.00	2.67	3.56	1.82	1.74
Cuneo	14.00	0.00	1.70	1.19	0.61	0.58
Como	6.00	2.00	2.73	1.38	1.10	0.28
Cremona	53.00	1.00	7.43	5.57	2.99	2.58
Cosenza	7.00	6.00	6.85	5.01	4.48	0.54
Catania	12.00	11.00	12.46	9.71	8.69	1.01
Catanzaro	9.00	3.00	4.09	2.99	2.38	0.61
Enna	33.00	5.00	9.01	9.52	6.61	2.92
Forli-Cesena	12.00	5.00	6.46	2.83	2.32	0.51
Ferrara	22.00	8.00	10.67	5.85	4.68	1.16
Foggia	10.00	6.00	7.21	6.07	5.22	0.85
Firenze	38.00	12.00	16.61	8.16	6.34	1.82
Frosinone	51.00	4.00	10.19	7.87	4.88	2.99
Genova	15.00	11.00	12.82	6.08	5.32	0.76

Province	$F_{-i,2010}$	$F_{i,2010}$	$\widehat{F}_{i,2010}$	$\widetilde{Y}_{i,2010}$	$\widetilde{\widetilde{Y}}_{i,2010}$	$\widetilde{Y}_{i,2010} - \widetilde{\widetilde{Y}}_{i,2010}$
Gorizia	22.00	0.00	2.67	2.22	1.13	1.08
Grosseto	24.00	0.00	2.91	2.38	1.22	1.17
Imperia	0.00	0.00	0.00	0.00	0.00	0.00
Isernia	24.00	1.00	3.91	3.88	2.26	1.62
Crotone	9.00	0.00	1.09	1.66	0.85	0.80
Lecco	5.00	0.00	0.61	0.45	0.23	0.22
Lecce	1.00	8.00	8.12	5.64	5.56	0.08
Livorno	11.00	0.00	1.34	1.08	0.55	0.52
Lodi	43.00	0.00	5.22	4.38	2.22	2.17
Latina	47.00	0.00	5.70	5.60	2.82	2.78
Lucca	31.00	0.00	3.76	2.80	1.42	1.37
Macerata	17.00	10.00	12.06	6.59	5.63	0.96
Messina	22.00	11.00	13.67	11.04	9.22	1.82
Milano	21.00	33.00	35.55	13.77	12.74	1.03
Mantova	40.00	0.00	4.85	3.37	1.70	1.66
Modena	25.00	7.00	10.03	4.62	3.55	1.07
Massa Carrara	12.00	0.00	1.46	1.32	0.68	0.64
Matera	23.00	2.00	4.79	4.46	2.85	1.61
Napoli	20.00	23.00	25.43	22.17	20.11	2.05
Novara	47.00	3.00	8.70	5.83	3.52	2.31
Nuoro	20.00	0.00	2.43	2.70	1.38	1.31
Oristano	20.00	0.00	2.43	2.98	1.53	1.45
Otranto	0.00	0.00	0.00	0.00	0.00	0.00
Palermo	11.00	11.00	12.34	9.16	8.27	0.89
Piacenza	33.00	3.00	7.01	4.08	2.61	1.47
Padova	11.00	13.00	14.34	6.29	5.75	0.54
Pescara	14.00	3.00	4.70	3.36	2.49	0.86
Perugia	33.00	11.00	15.01	9.31	7.31	2.00
Pisa	19.00	11.00	13.31	6.51	5.54	0.97
Pordenone	15.00	0.00	1.82	1.40	0.72	0.68
Prato	26.00	0.00	3.16	2.43	1.24	1.19
Parma	16.00	12.00	13.94	6.00	5.26	0.74
Pistoia	33.00	0.00	4.01	3.42	1.74	1.68
Pesaro-Urbino	17.00	9.00	11.06	5.68	4.79	0.89
Pavia	41.00	8.00	12.98	7.88	5.67	2.21

Province	$F_{-i,2010}$	$F_{i,2010}$	$\widehat{F}_{i,2010}$	$\widetilde{Y}_{i,2010}$	$\widetilde{\widetilde{Y}}_{i,2010}$	$\widetilde{Y}_{i,2010} - \widetilde{\widetilde{Y}}_{i,2010}$
Potenza	31.00	6.00	9.76	8.05	5.82	2.23
Ravenna	37.00	0.00	4.49	3.44	1.75	1.70
Reggio Calabria	3.00	4.00	4.36	3.24	3.00	0.24
Reggio Emilia	17.00	4.00	6.06	3.11	2.34	0.77
Ragusa	12.00	0.00	1.46	1.84	0.95	0.89
Rieti	63.00	0.00	7.65	7.76	3.88	3.89
Roma	14.00	38.00	39.70	16.77	15.99	0.78
Rimini	13.00	1.00	2.58	1.47	0.93	0.54
Rovigo	32.00	0.00	3.88	2.98	1.51	1.46
Salerno	26.00	10.00	13.16	10.51	8.47	2.05
Siena	39.00	8.00	12.73	7.12	5.17	1.95
Sondrio	19.00	0.00	2.31	1.56	0.80	0.76
La Spezia	21.00	0.00	2.55	2.13	1.09	1.04
Siracusa	11.00	1.00	2.34	2.26	1.46	0.79
Sassari	0.00	11.00	11.00	6.76	6.76	0.00
Savona	14.00	0.00	1.70	1.35	0.70	0.66
Taranto	20.00	4.00	6.43	5.86	4.29	1.57
Teramo	10.00	5.00	6.21	4.07	3.43	0.65
Trento	14.00	7.00	8.70	3.84	3.22	0.62
Torino	4.00	14.00	14.49	6.39	6.18	0.21
Trapani	11.00	0.00	1.34	1.80	0.93	0.87
Trani	24.00	0.00	2.91	2.76	1.41	1.35
Trieste	0.00	12.00	12.00	4.33	4.33	0.00
Treviso	18.00	0.00	2.18	1.66	0.85	0.81
Udine	5.00	10.00	10.61	4.52	4.28	0.24
Varese	37.00	6.00	10.49	5.89	4.12	1.77
Verbania	10.00	0.00	1.21	1.14	0.59	0.55
Vercelli	28.00	1.00	4.40	2.99	1.71	1.28
Venezia	23.00	5.00	7.79	3.99	2.95	1.04
Vicenza	25.00	0.00	3.03	2.16	1.10	1.06
Verona	25.00	7.00	10.03	4.98	3.83	1.15
Medio Campidano	0.00	0.00	0.00	0.00	0.00	0.00
Viterbo	44.00	6.00	11.34	8.31	5.63	2.68
Vibo Valentia	6.00	0.00	0.73	1.01	0.52	0.49
Total	20.25	4.75	7.21	4.69	3.53	1.16

Notes: Percent shares $\widetilde{Y}_i/Y_i * 100$ and $(\widetilde{Y}_i - \widetilde{\widetilde{Y}}_i) * 100/Y_i$. $\widetilde{Y}_i$ and $\widetilde{\widetilde{Y}}_i$ come from equations (4) and (5); Y_i is VA per capita of province i. All values refer to 2010. Information on Y_i is not available for provinces of Barletta, Carbonia-Iglesias, Fermo, Monza-Brianza, Medio-Campidano and Ogliastra.