Local Competition in the Supply of Tertiary Education: Evidence from Italy*

Elena Cottini (Universita' Cattolica di Milano),

Paolo Ghinetti (Universita' del Piemonte Orientale)

Simone Moriconi (Universita' Cattolica di Milano)

Very Preliminary Version - please do not quote

Abstract

This paper exploits a own built dataset on the foundation of higher education institutions in Italy during the period 1861-2010 to analyze the effects of spatial competition and strategic interactions in the local supply of higher education. We measure the latter by the number of faculties in each province, as a function of the supply of neigbours. Our empirical strategy relies on instrumental variables that exploits the effect of initial conditions of the Italian higher education system (i.e. pre-existing Italian unification occurred in 1861) on higher education supply, through reforms implemented over the period 1870-2010. Results show evidence of strong competition effects in the supply of higher education at the local level: our more conservative estimates suggest that having 6 more faculties in the neighborhood reduces the local supply of higher education by about 1 faculty. This local competition effect is generally concentrated within the same field of study, while it is lower between different fields. We also show that this provincial competition has significant beggar-thy-neighbor effects, by inducing roughly a 2.5 percent loss of local per capita productivity.Our results suggest also heterogeneous effects of higher education supply on the extensive margin (labor participation) and the intensive margin (productivity per worker).

Key Words: spatial competition, universities, supply of tertiary education

JEL codes: I23, I25, N33, N34, R1

---

1 Introduction

In many higher education (HE) systems, a key feature is the competition among providers of university education which confront an increasing private and social HE demand (Hoxby, 2015). In many European countries, increased demand and supply contributed to a major expansion of the university systems, in terms of both number of students enrolled and number of institutions involved in the market. This is a process that speeded up in the last few decades but was in place throughout the past century.

Figure 1 documents the supply side of this phenomena, showing the evolution of HE systems in terms of the number of universities (ateneo) in France, Italy, Germany and UK, from mid nineteen century to 2009. For all countries, Figure 1 shows a positive and somewhere moderate trend until the 60s or 70s, when numbers increased at a faster pace almost everywhere. This is the supply reaction to the initially moderate and then more pronounced demand shift from an 'elite' to a 'mass' university system occurred in those years. In the present study we focus on Italy, which possesses a flatter profile and can be considered a sort of "lower bound" country in this context. There are several reasons for the Italian trend, for example the persistently lower number of high school graduates compared to countries like Germany, especially in the last 40 years. However, also for the "lower bound" Italian case, the growth was substantial, and in 2009 the number of universities was 3 times more than in 1859.

Another important feature of HE systems is that the (rise in the) number of universities does not fully account for the (expansion in the) supply. As shown by figure 2 for Italian case, a more appropriate metric to analyse supply dynamics and competition is the number of faculties (numfac), which increased much more than that of universities. Unsurprisingly, this reflects into higher average number of faculties per university (av numfac) over time. In this respect, the number of faculties accounts for both the intensive margin (new faculties in existing universities) and the extensive one (new universities consisting of new faculties), and provides a more effective way of measuring changes in the provision of HE.

A key aspect, especially for policy purposes, is to shed lights on the determinants of these dynamics and on the mechanisms that determine these allocations. Do they correspond to the social planner target of a fully centralised HE system or, at least partially, do they reflect (local) competition in a partially decentralised setting? The answer is not trivial because in many European countries - including the Italy - HE systems are in an intermediate position between a centralised setting and a decentralised one.

On the one hand, the HE market is centralised, on both the demand and supply side,

Figure 1: Evolution in the supply of higher education 1859-2009 in France (FR), Germany (DE), UK and Italy (IT): n. universities
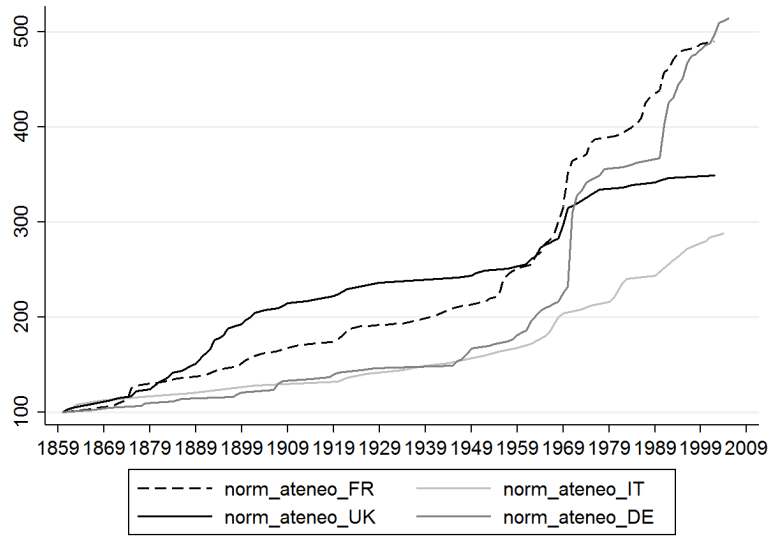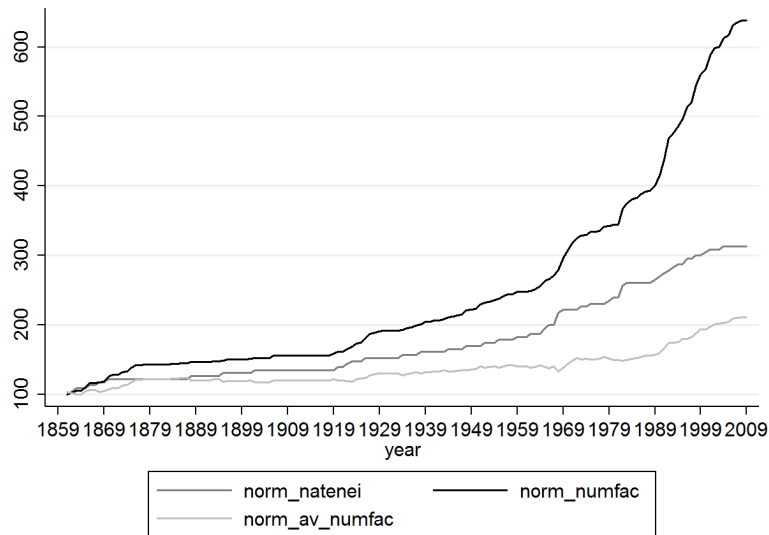

Figure 2: Evolution in the supply of higher education 1859-2009 in Italy: n. faculties, universities and faculties by university ratio

because the central government regulates the national HE system and is responsible for its general and log term objectives, so that, for example, supply adjustments such as opening of new faculties in incumbent institutions or the opening of new ones are subject to national rules, which are however rather flexible.

On the other hand, within the national regulatory framework and central supervision, the decisional process involving institutions and actors operating in the HE systems is substantially decentralised, both in terms of decision autonomy (Eurydice, 2010) and at the territorial level (OECD, 2008).

In this context, a spatially decentralised decisional process may produce lack of coordination, and the (territorial) competition between HE providers may produce outcomes which, at least transitory, may not be fully consistent with centralised targets. What are the implications for the efficiency of HE provision?

The aim of this paper is to analyse whether in the Italian system there exists local competition in the supply of HE, where providers of university education compete each other across close territories. More specifically, we estimate a spatial econometric model to investigate to what extent the number of faculties within a given territory reacts to the number of faculties in its neighbourhood.

The level of aggregation at which we define our units of observation is the province, which corresponds to the NUTS3 level. We ask the following question: does the existence of a higher education institution in a neighbouring province hinder the local supply of tertiary education? This type of analysis entails for an assessment of the spatial substitutability between majors within and across different disciplines (humanities, stem, social sciences).

To investigate competition in the supply of tertiary education, we first collect and then use an own-built historical dataset on the formation of tertiary education institutions in Italy (History of Italian Universities - HIU). This records information on higher education institutions by university major and local administrative units (provinces), during the period since Italy became a unitary State (1861 - 2009). To identify spatial causal effects, we use an IV procedure that exploits exogenous variation associated with the early life conditions of the Italian education system (i.e. the supply of higher education inherited by the pre-existing states) interacted with nine comprehensive reforms that took place over the period 1870-2010.

Our study is linked to the literature that looks at the long-run effects of institutional change on educational attainments (e.g. Woessman, ?). Our contribution is two fold. First, our analysis points out the effect of nine comprehensive reforms of tertiary education on the supply of tertiary education starting from the onset of the Italian history (1861-2010).

Second, we discuss the effects this process of expansion of higher education on the degree of spatial competition at the provincial level – in the provision of higher education services. The literature on this topic is rather scarce.

On the policy side, the amount of spatial competition in the supply of HE in Italy will give insights about the intrinsic nature of the Italian HE system, and in particular how much it departs from a fully centralised setting. Interdependent local decisions to supply HE across territories and geographical areas and the amount of spatial competition are very important policy issue for local development e.g. human capital, innovation (Valero and Van Reenen Valero and Reenen (2016)).

We find evidence of strong competition effects in the supply of tertiary education at the province level: our more conservative estimates suggest that having 6 faculties more in the neighbourhood reduces the local supply of higher education by about 1 faculty. This is definitely a non-negligible impact, considering that, on average the expansion of higher education that took place in the second half of the 20th century led to an increase by 4 faculties per province.

According to our estimates, this 'spatial displacement effect' is generally concentrated within the same field of study, being particularly strong among stem majors. Our first stage results also suggest that reforms of tertiary education deeply shaped the patterns of the expansion of competition in tertiary education in the Italian History. Reforms seem to have differential effect depending on the field of study.

The rest of the paper is organised as follows. In the next section we provide background information about the Italian administrative organisation and the HE system, as well as we frame our analysis in the literature, from both a theoretical and empirical point of view. In Section 3 we describe the date used in the analysis. The empirical model and the estimation strategy are discussed in Section 4, while Section 5 discusses the main results.

2   Background and literature

2.1   Institutional setting

The Italian HE system is prototypical of major European systems. In Italy, public institutions coexist with private ones, and enjoy some degrees of local autonomy, with strong attachment to the territory and its economic and political representatives. In addition, the HE supply is organised in currently about one hundred universities, highly differentiated between old and new ones, large and small, as well as regional and located in metropolitan

areas.

Since the unification of Italian territories in 1861 (fully achieved in 1870) into a single State, HE is regulated by the central government. However, the some degree of decentralisation is an important feature of the HE system. This has historical reasons: at the time of the Italian unification, the structure of the Italian university system was very decentralized, reflecting the fact that this was the simple aggregation of the university systems of the member states. A number of attempts were made by the new state to centralize the system (e.g. by homogenizing the quality standard the universities should comply with). However, for a long period these attempts where highly ineffective.

For our purposes and for the reasons explained in the Introduction, we use the Faculty as the relevant HE institution. In essence, it is the core teaching unit, and it is meant to govern the supply of HE in a given field of study.

Moreover, the genesis of a faculty is very often detached from a university and tailored to respond to local demand of HE services. In some circumstances, this has been taken at the extreme, and in the history of the Italian HE system there were cases in which the creation of the faculty is even antecedent that of the university.

On the one hand, this was due to institutional constraints. For example, until the first decades of the past century, only few tertiary education disciplines were taught at universities: medicine, law, Humanities, mathematics and natural sciences. All the scientific knowledge and the social sciences were taught by Schools (equivalent to single faculty institutions) recognised by the State and part of the HE system. They granted degrees in professional and technical subjects equivalent to university degrees on a legal standpoint, but were not part of any university.

On the other hand, in more recent years faculties are often established in a territory and supported by the local economic and political representatives before the creation of a new university, as separate branch of an existing one, which aims at expanding its influence on a wider area. For example, in 1993 seven new faculties were opened in the Eastern Piedmont by the University of Torino (Western Piedmont) and only in 1998 they gain autonomy by the creation of the brand-new University of Eastern Piedmont.

The case of the University of Turin is not isolated, and several multi-branch universities have faculties in multiple provinces, such as the University of Insubria, which is present both in Varese and Como.

These few examples suggest that variation in the number of faculties is likely to capture key features of competition in the supply of HE, and that the local dimension of competition

is an important part of the story.

We analyse spatial competition at the province level, i.e. we locate faculties in the territory and use provinces to divide that territory in administrative units; we use the relative position of such units to define which units are their neighbours, which are expected to compete in the number of faculties if there exists some degree of spatial dependence across contiguous provinces.

We select the province (NUTS3 territorial level) as the relevant level of aggregation and not the region (NUTS2) of the municipality (NUTS4) for a couple of reasons. First, because it is the oldest governance level, that even preceded the national one. It is the equivalent to the French Departments, extended by Napoleon to Italian territories.

Second, because the analysis of the evolution of the Italian HE system suggests that the province level is the smaller scale at which university services can be efficiently supplied. And perhaps is also the adequate territorial scale to satisfy the local demand for HE, whose width is on a comparable scale. In a sense, we feel that given their high fix costs, providing university education on a smaller territorial scale would not be efficient as it would imply too much differentiation.

Third, if we conducted the analysis at the municipality scale we would end up with an higher amount of zeroes, since many municipalities never had a faculty in their territory and so did their neighbours. By converse, if we step up at the province level we see a much more dense pattern, suggesting that this is the more disaggregated level at which analysing competition in the supply of tertiary education.

This is not surprising. According to the definition given by Petracchi (1962), the province is "a big association of municipalities devoted to the protection of the rights of each of them, and to the management of their collective moral and material interests".

2.2 Economic framework and relevant literature

As in any centralised setting with only mildly binding regulations, we expect there exists decentralised competition across territories, and the local providers of HE may not fully internalise the overall central objectives, producing externalities on other actors and on the system as a whole. The actors involved in local competitions are not only the universities representatives, but also that of local interests and economic conditions. In this context, the location of HE providers and their each other distance are important features of the HE market. Indeed, as many other socio-demographic and economic activities, the private and social demand for higher education may have an important spatial and local dimension.

In general, the actors involved in such spatial competition are all the parties able to collect information about the local demand for HE (in terms for example of local preferences) and to arrange the local production of HE. Typically, universities, local authorities and representatives of the local economy (local banks, chambers of commerces, and so on).

In the end, local competition (if any) in the supply of HE is not just competition between universities, but perhaps between territories, which compete spatially to appropriate the largest share of the local demand for HE which possibly overlaps different territories.

Arguably, the local dimension of the shift in HE demand and of the associated supply adjustment may have gained higher importance over time. For example, while we do observed and still do flows of university students across countries or from poorer to richer regions within countries, the shift from an elite to a mass university system may have attracted rather immobile students, because of high direct and opportunity costs from going to the university at all, and especially unless it is not so far from home. This implies that neighbouring territories can attract each others' students.

Also in a centrally regulated system, leaving some degree of autonomy and favouring a spatially decentralised supply has some costs in terms of lack of coordination and negative externalities which is likely to produce too much spatial differentiation as compared to the social optimum (standard result in Hotelling or Salop type models of spatial differentiation); but it also has some advantages. For example, a decentralized supply of HE favours exchange of information (e.g. between students and local economic environment) and favours a better tailoring of the supply of HE to the local needs. Moreover, a bottom-up HE system promotes more quantity and variety in supply of HE. However, the theory suggest that in the decentralised solution the coordination costs of a spatially decentralised system more than compensate the advantages of having more variety in the supply of HE at the local level, so that a centralised solution would be preferable from a welfare standpoint. While we will not be able to evaluate welfare effects associated with spatial differentiation, we will estimate the main effects of a decentralised supply of HE in terms of vertical differentiation of HE between Italian provinces.

Our main contribution is to the literature that looks at the long-run effects of institutional change on educational attainments. Woessman **?**, and Schutz et al. Schtz et al. (2005), use student-level data from 39 countries to trace back international differences in students performance to key cross-country differences in institutional design e.g. with respect to the degree of school autonomy, competition from private schools, and extent of equality in the education opportunities. They adopt a cross-country approach, which makes it difficult to identify the causal effect of institutions, due to the country unobservables. Education

institutions in fact evolve very slowly, so the appropriate data should display a long enough time dimension, so an historical perspective is needed to account for time invariant specific factors. Braga et al. Braga et al. (2013) move a step in this direction and exploit variations associated with reforms to education institutions in 24 countries over a long time span. They show that education reforms that expand access to education increase average years of schooling and reduce education inequality. Reforms that rise school accountability and autonomy, are also found to increase average years of schooling, but also increase inequality. [1]

Our contribution to this strand of the literature is two fold. First, our analysis points out the effect of nine comprehensive reforms of tertiary education on the supply of tertiary education starting from the onset of the Italian history (1861-2010). Second, we discuss the effects this process of expansion of higher education on the degree of spatial competition at the provincial level – in the provision of higher education services. The literature on this topic is rather scarce. Up to our knowledge there are papers that discuss competition in the provision of other public services such hospitals (see e.g. Brekke et al. Brekke et al. (2015)), while ours is the first contribution that studies the spatial competition in the supply of education. A major issue that prevented the literature to go in this direction is the lack of data, featuring a suitable institutional variation. Education institutions evolve very slowly, so the appropriate data should display a long enough time dimension. The geographical partition is also very important, as it should be diverse enough to identify spatial differences in the provision of education services, and fine and precise enough to be able and identify neighbourhood effects. As I will explain later on, and up to our knowledge, HIU is the first dataset that is fully satisfactory in all these respects.

3   Data and descriptive statistics

3.1   The History of Italian Universities Database

Our main source of data is an original and own-built dataset on the History of Italian Universities (HIU) that collects detailed historical information on the supply of tertiary education in Italian provinces in the period 1861-2010.

---

[1]the literature is much more vast when it comes to specific policy and reforms, which however do not entail an institutional change. For example, Hoxby and Turner Hoxby and Turner (ated) evaluate policy interventions that improve the access of low-income students to college related information (i.e. application process, college net costs). They show that this intervention makes low-income high performing students more likely to apply and being admitted to more colleges, especially those with higher graduation rates and offering students more instructional amenities.

What we constructed is basically the registry of institutional providers of tertiary education in Italy since 1861 to 2009. The logic is very much the same as registry data for individuals. The difference is that our individual or, better, our unit of observation is the faculty, while the household is the university it belongs to. For every unit of analysis (faculty) we trace the history from birth. We reconstructed the year of establishment as a provider of HE services, the relevant changes to legal status (e.g. autonomous school or within a university, shifts public/private, movements from an incumbent university to a new born one,etc), the university the faculty belongs to, the province in which the faculty operates, the university address and the faculty address. Of course, we also record the faculty major, grouped in 14 faculty-groups, 6 disciplines, 3 fields of study, according to the official classification used by the Italian National Statistic Office (ISTAT) in its survey on labour market perspectives of university graduates.

We observe only births of new faculties and/or universities since a key feature of the Italian university system is that there are no deaths of universities or faculties: the new born are added gradually to the existing ones. No faculty/university ever died in the period of record between 1860 and 2010. Ultimately, our dataset observes all demographic changes of the same subject-faculty.

The dataset includes information on number and characteristics of universities (year of origin, relevant changes in the legal status), faculties and majors by year of introduction.Faculty majors are then grouped in 14 faculty-groups, 6 disciplines and 3 fields of study (see ISTAT, survey on University Graduates for definitions), year of establishment (e.g. start of Higher Education services provision), relevant changes to legal status (e.g. autonomous school or within a university, public/private, etc.), University the Faculty belongs to, University address and faculty address.

The process of data collection is key in this context, and we put a lot of effort to be as careful as possible. We derived our original dataset from different archives. The main data source is "Storia dell'Universit Italiana" by Brizzi et a. (2007), which is a volume that collects all information about Italian Universities since political unity in 1861 to the beginning of the new millenium. We integrated this information with historical publications about the genesis and developments of specific universities (e.g. Fois, 1991, on the University of Sassari) and faculties (e.g. Silvestri, 2006, on engeneering. We also took advantage of the historical section of university websites as well as faculty websites, the latter accessed through web archive machines available in the net. In case of conflicting information we double checked directly by contacting the university administration and referring to official sources such as the Gazzetta Ufficiale, a weekly publication which since 1861 collects all the

new laws, norms, news, facts and every public act taken by Ministers (including University and Education) that has relevancis relevant for the socio-economic environments in Italy (e.g. approval of the statute of a given university, or a new regulation of a field of study, etc). The resulting original dataset contains location and characteristics of nearly 600 universities over a period of 150 years.

Data collection stops in 2010 because after that data we cannot track any longer the faculty, due to a faculty reform that reassigns it to the university departments. In the Appendix we provide a detailed description of data sources and the definition of all the variables that will be used in the empirical analysis in the following sections.

Our working HIU sample is constructed excluding all universities that do not have a formal faculty, excluding on-line universities and Universities that do not release a bachelor degree, but only a MSc or a PhD degree. After this cleaning process we obtain a final sample with 578 Universities.

3.2 Main variables and Descriptive Statistics

We collapse our census archive to construct a province by year dataset, which, for each province i existing at time t counts the number of faculties present in its territory, both overall and by majors. This is a unbalanced panel data for about 110 Italian provinces during 1861 - 2010. The panel is unbalanced because the number of provinces changed throughout the time span. This happens for three reasons.

First, because not all the Italian territory was part of the Italian State since 1861. For example, the areas under the Pope jurisdiction joined Italy only in 1870. We account for that by excluding the years before 1870 from the estimates. Second, because other territories formerly part of Austria joined Italy after the first world war in 1918. The provinces located in the extreme north of Italy that were part of this process enter the sample in 1918.

Third, because the way in which the Italian territory was divided into administrative provinces changed in the period of observation. In particular, their number increased over time, so that at the beginning the average extension of a province was larger. For example, the territory under the administration of the province of Milan until mid '90s included the city of Monza, which now belongs to newly founded province of Monza. Once a new province is born, it inherited the number of faculties present in its territory, which no longer counts for the donor province whose terrotorial extension is now smaller. To the extent which this duplication of provinces is independent to the process of local competition in HE, and we found no reason for not excluding that, this should not affect our estimates.

The main variables available for province by year cell are the number of faculties in province i, and also how they are divided into humanities, stem and social sciences. We also record information on the number of universities, either the total number and that of private universities, as well as the neighborhood matrices, computed in terms of contiguity. The neighbours are provinces $-i$ which share an administrative border with the i-th.

We begin by presenting some descriptive statistics at the macro level. Figure 3 gives an historical overview showing a screenshot on the number of faculties by field in 1870s as compared to 2009. We clearly see an expansion of tertiary education in the post-war period, which coincides with the change from an elite to a mass status of the Higher Education Sistem and which was very diffused . Our data reflect the pattern of development of tertiary education described in institutional reports and methodological studies (see e.g. OECD, 1999, 2008). In Figure 2 shows how the total number of majors has evolved over time; with a sharp increase after 1970s. Social sciences show the steepest increase.

In the appendix, we replicate Figure 3 by field of study, comparing the distribution by province in 1870 and 2009. In panel a) we show the changes with respect to the scientific field, while in panel b) and c) Social Sciences and Humanities, respectively. We can notice that the timing of the expansion path depends on the field of study, being a wider diffusion that of social sciences.

Summary statistics for the main variables are in Table 1. About 11,800 observations are available for the estimates. On average, there are about 2.5 faculties and 0.5 universities for each province. The province with the higher supply of HE has 38 faculties, while the maximum average number of faculties in the neighbourhood is about 17. Stem and social science majors are relativeli more diffused than humanistic ones.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
no. of universities in i	0.497	0.841	0	7	11861
av. no. of universities in $-i$	0.55	0.398	0	2.667	11861
no. of faculties in i	2.509	4.145	0	38	11861
av. no. of faculties in $-i$	2.878	2.166	0	17.333	11861
no. of private universities in i	0.078	0.363	0	4	11861
av. no. of private universities in $-i$	0.089	0.196	0	1.333	11861
no. of humanistic faculties in i	0.477	0.988	0	11	11861
av. no. of humanistic faculties $-i$	0.534	0.544	0	4.333	11861
no. of stem faculties in i	1.079	1.688	0	8	11861
av. no. of stem faculties in $-i$	1.269	0.903	0	5	11861
no. of social sciences fac. in i	0.946	1.761	0	21	11861
av. no. social sciences fac. in $-i$	1.064	0.932	0	9.667	11861

Figure 3: Diffusion of faculties in Italy

No. of Faculties 1870

0
[1, 8]

No. of Faculties 2010

0
[1, 8]
[9, 14]
[14, 38]
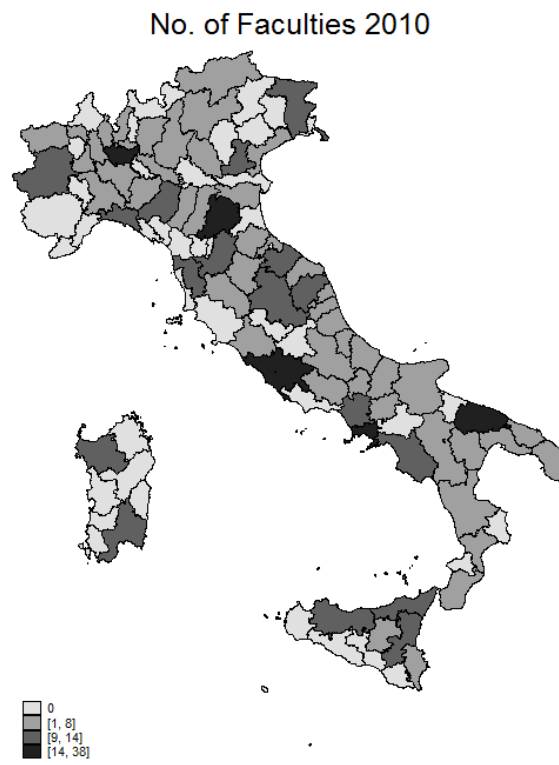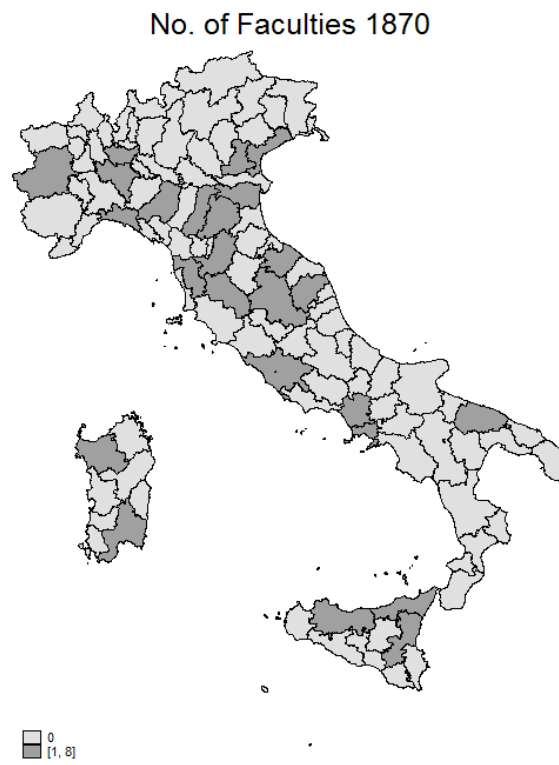
Figure 4: Evolution in the number of majors in Italy in 1860-2009.

Note: Social sciences include Law, Socio-economic area, Engineering and Architecture
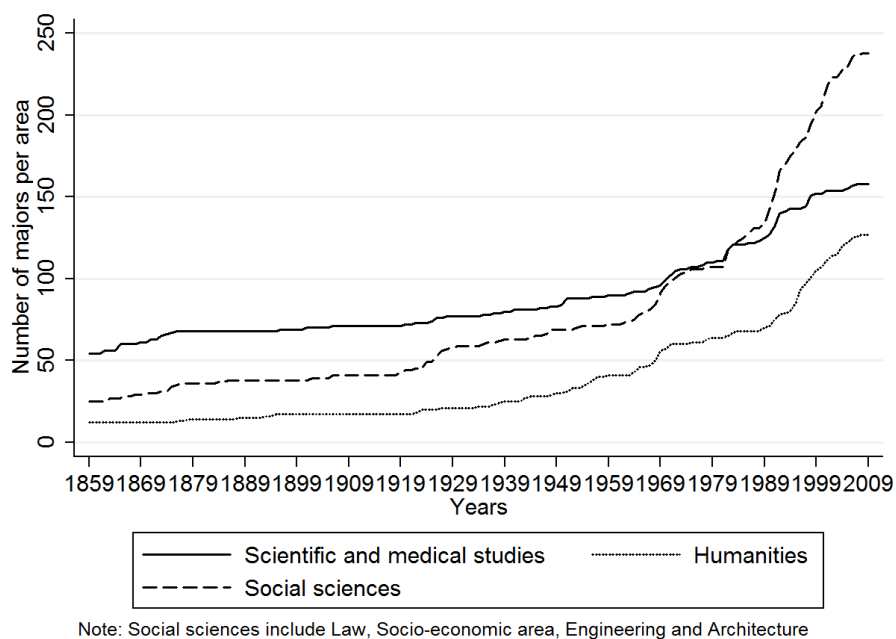
4 Empirical analysis

4.1 The model

We use our province by year panel dataset outlined in the previous section to define a model of horizontal spatial interactions where the number of faculties F existing in the i-th Italian province at time t is influenced by the number of faculties in the neighbouring provinces. In our baseline model, they are those provinces that share a border with the i-th province, and may belong to the same region or to a different one.

This spatial interaction can be modelled in several ways. We first follow the standard approach in the literature (Brueckner, 2003), and assume that each province reacts to what happens to its 'average neighbour', which corresponds to the weighted average of faculties among its neighbours $\overline{F}_{-it}$. This can be interpreted as a probability that a representative neighbour of province i has a given number of faculties - overall or in a given field of study - at time t. The union of sets i and $-i$ defines the bundle of provinces exposed to spatial competition for the local demand of HE.

A simple way to model this relationship is through the following linear spatial competition model:

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

14

where $|gamma_i$ and $\delta_{r(i)t}$ are, respectively, province and region-by-year fixed effects. The latter refer to the region r to which the province i belongs, evaluated at time t. The weighted average is defined as: $\overline{F}_{-it} = \sum_{j \neq i}^{N} w_{ij} F_{ij}$, where w_{ij} is a set of weights. The neighbour is not restricted to the same region, but it may include provinces across the region border. Some covariates X at the province level may be included as additional regressors. δ is the coefficient of interest as it captures local strategic interactions among close provinces.

Second, we follow an alternative procedure, the so called 'pairwise approach' as in Parchet (2014), which treats each pair of neighbours separately, allowing in principle for differences in the strategic response of each province to different close competitors. Hence, each pair of neighbours contributes separately to the estimates. Under this approach, equation (1) when estimated for all pairs of border provinces takes the following form:

$$F_{ijt} = a + dF_{jt} + g_{ij} + d_{r(i)t} + (X_{it}\beta) + e_{ijt} \tag{2}$$

where F_{jt} is the number of faculties in a neighbouring province j of province i, while g_{ij} is the fixed effect of the pair. Note that each pair appears twice, with a given municipality being once on the left-hand side and once on the right-hand side of the equation. d is the effect of main interest and captures the average response of province i to HE supply of neighbour j.

These two models are estimated also by fields of study and by looking also at the extensive margin (at least one faculty in $-i$ vis a vis at least one in $-i$) as an alternative to the intensive one.

The models (1) and (2) imply contemporaneous spatial competition. The underlying hypothesis is that the interaction over time between a province and its neighbours in the supply of higher education implies that province can react immediately to variation in the number of faculties of close provinces by adapting its own supply. This may not be the case if these processes have some inertia due to the fact that several actors are involved in the decision of opening a new faculty (the local government, the university in which the faculty is opened, the representatives of the local economic and banking system, etc.).

We experimented by modelling strategic interaction through lagged effects, which account that strategic interactions is a dynamic and perhaps sequential game. In general the results are quite similar, with the additional complication that it is difficult to define an optimal lags structure. For sake of simplicity we abstract from these complications and use contemporaneous effects, which may be interpreted as an approximation of the underlying dynamic game, to isolate the structural component of the strategic interaction effect which emerges as a steady-state equilibrium.

4.2 Estimation issues

The models (1) and (2) are in the standard fixed effects regression format, and can be easily estimated by OLS. For model (1), a key aspect is the choice of the weighting matrix. In the baseline specification, the weights are settled to reproduce sample means, i.e. any neighbour is given the same weight: $w_{ij} = \frac{1}{N}$. We check the robustness of results using alternative definitions of spatial weight, proportional to the inverse of the distance between provinces.

Province fixed effects a_i (province-specific intercepts) control for all unobservable time-invariant specific characteristics of the province which may affects the HE decisions of neighbours. Region-by-year fixed effects allow for specific region intercepts, that differ for each year. In such a way, we control for all events at the region level - including region and year specific HE policies that influence the diffusion of faculties - that affect all the provinces in that region simultaneously and identically. .

The heterogeneity that is left is basically the variability over time across provinces within the same region, that is, the fact that two provinces that belong to the same province may over time deviate from their average province fixed effect. In the end, identification of δ is obtained through the comparison of different time-varying patterns in the number of faculties across provinces.

The main issue in the estimation of equation (1) arises because the number of faculties of a neighbouring set of provinces itself depends on the number of faculties of municipality i: specific time-shocks that hit province i and induce a change in F_{it} may induce the neighbours to react by adjusting $\overline{F}_{-it}$, giving rise to a reverse causality problem. Moreover, many time-varying determinants of one province's number of faculties, such as local economic conditions or local demand for tertiary education, are likely to be unobservable and spatially correlated with that of the neighbours (provinces in the same region or in different regions), such that $cov(\epsilon_{it}, \overline{F}_{-it}) \neq 0$.[2] This creates an endogeneity issue that, together with reverse causality may bias the OLS estimation of (1).

As about model (2), selection is maybe less severe but qualitatively similar: in particular, the pair common trend a_{ij} may not capture province-specific unobservable features correlated each other, in particular when the province j belongs to a different region.

To deal with selection problems we follow an empirical strategy based on instrumental variables, applied to the pairwise model only. We do not estimate model (1) by IV because an instrument may individually affect all the neighbours F_{ij}, but in different directions, so

---

[2]If (some of my) border provinces are not in my region, also if these unobservable shocks were region specific, they are not captured by region-by-year fixed effect; if the border province is in the same region of province i, its province-specific shocks correlated with e_{it}.

that the aggregate effect on the weighted average $\overline{F}_{-it}$ may disappear, causing a problem of weak instruments. The pairwise model does not suffer from this aggregation issue and it is therefore preferable in our setting.

4.3 Identification

The key for identification is to isolate variations in number of faculties of competing jurisdictions that can be plausibly considered exogenous. We propose to identify spatial interactions among provinces in the number of faculties by using state-level university reforms (R_t) interacted with the initial geographical distribution (initial conditions) of faculties of the neighbouring province(s) (ICj): $R_t * ICj$, where $R_t = 1$ if $year >= t$ and 0 otherwise.

While state-level reforms affect in principle all the jurisdiction in the same way, the interaction with the initial conditions allows to recover variability at the province level and to exploit the fact that the same general reform in higher education may have differential effects depending on the initial endowment of faculties in the provinces. As usual, instruments need to satisfy two conditions. First, they have to be exogenous to HE decisions of individual municipalities, that is $cov(F_{ij}, e_{it}) = 0$. Second, they should be relevant, i.e. they should imply enough variation in F_{it}.

The exogeneity assumption must holds for both the reforms and the initial conditions. About the latter, they are likely to be exogenous since they reflected mostly the decisions of the States existing in Italian peninsula before it became an unique State. These pre-existing States were often in conflict, had their own institutions and in general were not coordinating at all their decisions in any area of public provision, including higher education. Hence, the Italian university system at the beginning of its life was inherited from the past, and the initial distribution of faculties across provinces mainly exogenous.

With a 1859 law ('Legge Casati'), progressively extended until 1870 to all the territories that progressively joined the Italian State before its complete unification in 1870, the newly founded Italian Reign just progressively included in its university system all the universities existing in pre-unity States, with their specificities, without imposing any substantial change. While it is true that for any province the initial conditions are correlated with the subsequent development of the university system (relevance of the instrument), what is key for identification is that the initial distribution of faculties of the j and i provinces are uncorrelated, which is true if they belonged to different states and which it is often the case in our sample.

For the territories annexed to Italy post 1870, the initial condition is the number of

17

faculties existing in the province at the time of joining. For the "new" provinces obtained by splitting the pre-existing ones, they are endowed with the number of faculties that in 1870 existed in the territory that eventually will become at some point a new province (and in most cases the initial endowment computed in this way is simply zero).

Since initial conditions are fixed over time, they would blur into the pair fixed effects. For this reason we use law interventions in the university system as another source of exogenous variation, which is fixed across provinces, but which varies over time. In particular, we focus on general reforms of the university system, i.e. law interventions with a general purpose and not those intended to regulate some specific need of a limited set of universities.

We draw on and look at reforms that modified the degree of autonomy of Italian universities (in terms of curricula, budget, staffing), or that implied an expansion of the university access by opening the access from secondary schools or by 'liberalising' the geographical expansion of universities (Braga et al. Braga et al. (2013)).

In this case, the key point for identification is whether (upper-level) state decisions are arguably exogenous to the (lower-level) province decisions. This imply two requirements.

First, that individual provinces do not systematically affect state-level tertiary education policies (no reverse causality). This rules out the possibility that a province which wants to modify its supply of HE (measured by the number of faculties) has enough policy power to influence the State decisions the about the general asset of the university system. This is likely to happen in Italy, where there is a sufficiently high number of provinces and the population is not too concentrated in certain areas, which would give them enough political power to influence state-level decision. Hence, while the province is the relevant jurisdictional level for decisions about the supply of local HE - and this implies interactions with the Central government and Parliament to express collective local preferences -, it is rather unlikely that any province has enough 'voice' and bargaining power to impose specific decisions on the Government and on the State when introducing substantial reforms of the university system.

Second, that state-level reforms are not driven by some 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 captures all the aggregate component of province-specific shocks.

The reforms we use as source of exogenous variation, are 10 major law interventions, starting from 1870. The first is the law R.D. 2102/1923 ('Gentile reform' from the name of the Education Minister at that time), which is first attempt to create an organic national university system, coherent in its objectives and with a clear structure. The universities were divided in two groups: A, fully financed by the State and B, partially financed.

In general, differently from before, the Universities (especially but not exclusively that of group A) were given adequate financial resources, which in many cases allowed them to complete their offer, in terms of both faculties and curricula. The perimeter of the higher education system was however rather limited, and the dichotomy between science and humanistic studies on the one hand, and technical studies on the other hand still present. Universities were organised in Faculties for humanistic and scientific studies, with at most some 'Schools' for mostly technical disciplines like Pharmacy. However the HE system included other institutions, different from the universities, that organised degrees in technical discipline such as engineering and architecture. Other fields of 'technical' study that are nowadays included in tertiary education - such as economics or management or commercial, or social sciences - were offered by tertiary education 'Schools' legally recognised by the State, but with different rules (access criteria, financing, validity of degrees, etc) and outside the University system.

The second main reform is due to the law R.D. 1592/1933 (known as the Devecchi-Bottai reform) and subsequent ancillary laws, which imposed a highly centralised system, without any residual substantial autonomy of universities in their decisions about their internal organisation and curricula. For the first time, by the end of 1938 all the technical disciplines in that 'grey' zone (part of the tertiary education but not organically included in the university system) gained university status, but the schools or the institutes offering these diplomas lost their autonomy, being aggregated as additional faculties to existing universities.

Except for some major interventions, the core of the 1933 reform survived until the mid '90s. In particular, until the end of the '60s, the university system survived substantially unchanged despite the increase in the number of students, result of the increase in the number of graduates from those secondary schools that gave direct access to the university system. in the '60s there were two attempts of major reforms to attenuate the degree of centralisation and to actuate the constitutional principle of university autonomy. However, these projects of reorganisation and increasing the degree of autonomy to answer the challenges imposed by a growing number of students were ineffective due to the lack of political support in the Parliament. Instead, there were a multiplication of 'ad hoc' or 'urgent' normative interventions that we do not consider as they were attempts to adapt to the exponential increase in the population of students, without any organic reform in the university governance, curricula etc.: spot interventions, without any project, any model or idea of what the university system should look like.

A key turning point was the Law 910 of 1969, which liberalised the university access to all students with a 5 year diploma of secondary education, including those from technical

schools that before 1969 did not allow university enrolment. This caused a dramatic increase in the population of university students, that, in turn, put a lot of pressure on universities, social, economic and political authorities to adapt the supply of tertiary education to cope with the massive increase in demand for university places. In essence, it was the point in which the Italian university system, still internally organised to serve the 'elite', is asked to provide tertiary education for the 'mass'. How the system responded to this shock is detailed in Figure 2, which shows a tremendous increase of university faculties after 1969, especially in social sciences such as economics and political studies, which is expected given that they are the natural choice of secondary school graduates from technical or education schools. For our purposes, one key point is whether this rise in the number of faculties translates into an increase in the local amount of HE and tertiary human capital. It is fair to say that, especially during the 1970s and 1980s, this was not necessarily the case: universities suffered from low investment and low productivity whereby only 6 percent of registered students graduated and 30 percent had out-stayed the maximum course time.

For these reasons, in the 70s and in the '80 there were some substantial interventions on various dimensions of the university system. First, the law 766/1973 introduced, among other things, the possibility of opening new faculties and locations to harmonise the geographical diffusion of universities. Second, the Presidential Decree 382/1980 authorised, on an experimental basis, a departmental structure with financial and administrative autonomy to coordinate research activities instead of control by individual professors, and created a range of new collegiate bodies such as the degree course councils to oversee teaching activities and coordinate coursework and students study plans. Third, the law 168/1989 established the Ministry of Universities and Scientific and Technological Research to coordinate university activities and allocate funding, and increased the institutional, administrative and cultural autonomy of universities by allowing areas which were previously subject to national regulations to be covered by the university statutes. Fourth, two law intervention in 1990 obliged universities to set up triennial development plans and allowed them to promote a mild reorganisation of teaching and curricula.

It is only in the '90s (about 30 years late the aborted attempts of the '60s) that the process of reform of the national university system produced a new institutional setting, which passing through many intermediate steps and contradictions. The main features of the reformed system were introduced, first, by the law 59/1997 (the so-called 'Bassanini liberalisations'), which granted universities financial and teaching autonomy in an attempt to simplify and deregulate public administration [3], and fully implemented with a major

---

[3]The development of curricula, previously defined by rigid tables established by the Ministry, was now the responsibility of individual universities which were guided by very general national regulations. The laws

reform in 1999, followed by a tuning intervention in 2004. Indeed, the Ministry Decree 509/1999 gave substantial content to the Constitutional principle of university autonomy, establishing only rather general principles and requirements, but leaving the universities free to decide about their organisation in Faculties and curricula, being subject only to budget constraints, plus additional requirements (e.g. equilibrium between the number of Faculty members and the number of curricula, the formal development of medium term strategic plans, etc.).

Interacted with the initial conditions, the reforms are exogenous shocks that modified the incentives and the net benefits of opening new faculties or changing the supply of tertiary education at the province level. We associate to each of the reforms outlined above a dummy variable which equals one from the year of the reform onwards and zero before. The idea is that, at any t each province and its neighbours face an university system that is the result of the stratification of current reforms and those inherited from the past, measured by the number of ones in the set of dummies associated with each reform. Basically, identification comes by the number of reforms at which at time t a province has been exposed since the first year it appeared in the sample, interacted by its initial endowment of faculties.

An interesting feature of our data is that, if we look again at Figure 2, the fact that until 1969 the number of faculties was following only a small positive trend means that our model of spatial competition uses for estimation especially the last 40 years of data, while, on aggregate, the contribution of the first 100 years of history is less important. In a sense, the first hundred years work in favour of no competition, which may however be endogenous as well. Indeed, the difficulty or even impossibility to open new faculties (mediated by the initial conditions) was induced by institutional setting, which *ex-lege* reduced the latent net benefit of opening new faculties. On the whole, our IV model exploit one big discontinuity in 1969 plus additional smaller discontinuities. Those post-1969 further increased the autonomy of opening new faculties at the province level. In the pre-1969 period, the environment was pretty stable, but, if anything we expect more effects from the 1923 reform, which increased autonomy and the opportunity to open new faculties especially in traditional fields like scientific ones.

provided norms for the development, planning and assessment of the university system and its activities and reorganised the university councils to make their representation more balanced.

21

5 Main results

5.1 Competition in HE supply

Table 2 presents the estimates of equation 2, based upon the average neighbour approach by Brueckner **?**. We present four sets of estimates. In Row (a), we estimate the effect of the average number of faculties in the neighbourhood of province i (i.e. the total number of faculties present in the neighbouring provinces divided by the number of neighbours) on the total number of faculties in province i at time t. In Row (b), we isolate the extensive margin of competition in HE supply i.e. we describe HE supply in province i as a dummy variable, which is equal to 1 if at least one faculty is present in province i at time t, 0 otherwise. In the same way we define the extensive margin of HE supply in the province's neighbourhood In Row (c), we focus on the intensive margin of competition i.e. describe the effect of competition, only on provinces that have at least one faculty in place in province i at time t. Finally, in Row (d) we investigate competition effects when we measure HE supply in terms of the number of universities (rather than faculties) operating in each province. We present also results from different specifications. In Column [1] we present results from simple OLS, with province fixed effects. In Column [2], we include region-by-year fixed effects, to control for time variation at the regional level e.g. in the demand for higher education. In Column [3], we include a set of province level controls, to control for unobserved time varying factors at the province level. These controls include the total number of universities, the number of *elite* universities, and private universities in province i at time t. Standard errors are always clustered by province.

Results from the preferred specification in Columns [3] show a negative coefficient, generally significant at conventional levels. Estimates in Row (a) suggest that a one standard deviation increase in neighbourhood's HE supply (equivalent to 2.17 faculties in the average neighbour) is associated with a reduction of HE supply in province i by $(2.17 * 0.48 =)1.04$ faculty, this effect being significant at the 1% level. Estimates in Rows (b) and (c) shows this negative effect is present both on the extensive and the intensive margin of HE supply, while becoming less precisely measured in the latter. Finally, estimates in Row (d) show that this negative effect persists, and is sizeable when we measure HE supply in terms of no. of universities in each province: an increase in the neighbourhood's HE supply by 1 university is associated with a reduction of the local HE supply by over 0.8 universities (Row (d)).

As they estimate an average effect of the neighbourhood's HE supply, the results in Table 2 are likely to be blurred by omitted and unobserved factors, which determine specific (and possibly heterogeneous) relationships between the local province and each province in

the neighbourhood In Table 3 we present estimates of regression model **??** estimated for all pairs of border provinces (all provinces in the neighbourhood of i). This pairwise approach implies an increase in the number of observations by more 4 times larger, as each province in our sample has, on average, about 4 neighbours in each year. In this way we can include in the regression a fixed effect for each pair of provinces i.e. account for any omitted and unobservable factor, which affects the relationship between province i and each neighbour. Pair fixed effects are replaced to the province fixed effects included in all specifications of Table 2.

Results from pairwise regression models confirm that HE supply of neighbouring provinces has a negative effect of the local HE supply. The comparison of these estimates with those reported in Table 2 suggests, that accounting for the pair fixed effects reduces the magnitudes of the coefficients. Results in Row (a) suggest that, on average, a one standard deviation increase in HE supply in a neighbouring province (equivalent to 4.35 faculties) is associated with a reduction of HE supply in province i by $(4.35*0.08 =)0.35$ faculties. This negative effect is present both on the extensive and the intensive margin of HE supply, and when we measure HE supply in terms of no. of universities rather than no. of faculties in each province.

As we discussed above, we resort to IV to tackle the remaining endogeneity concerns discussed above. Results from IV estimates are presented in Table 4. To ease comparison, we also present OLS FE estimates from our preferred specification, i.e. the one that applies the pairwise approach and measure HE supply as the total no. of faculties in each province (see Table 4, Row (a)). All specifications include pair fixed effects, region-by-year fixed effects and the usual set of provincial controls (see Table 4, Column [3]). In Column [1], we report this baseline set of OLS FE estimates. In Column [2], we report 2SLS FE estimates. In Column [3], we report 2SLS estimates including among the controls the number of universities in province j. Econometric tests confirm that the instruments are strongly correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage. The first stage results (reported in the Appendix) show that all reforms interacted with the initial HE conditions have some explanatory power over the expansion of HE supply in neighbouring provinces. Unsurprisingly, the largest increase are associated with the reforms that liberalized the university access to all students ($L.910/1969$), granted more funds to triennial development plans of HE institutions ($L.245/1990$)[4], and simplified the public administration ($L.59/1997$). Estimates in Columns [2] and [3] confirm a strong

---

[4]The effect of this reform cannot actually be disentangled by the reform that reorganized university teaching ($L.341/1990$). However, we deem the first reform as the most relevant one to the purposes of the present analysis. See Eurydice (1999) for details of all reforms.

negative impact of HE supply in a neighbouring province on the local HE supply: results in Column [3] suggest that, on average, a one standard deviation increase in HE supply in a neighbouring province is associated with a reduction of HE supply in province i by $(4.35 * 0.17 =)0.74$ faculties.

Overall, our results point to a strong negative effect of HE supply in a neighbouring province on local HE supply. Taken at their face value, the more parsimonious results from Table 4 indicate that HE supply in a province with 4 neighbours, may end up decreasing by $1.4 - 3$ faculties, when HE supply decreases by about 4 faculties in each neighbouring province. This negative effect can be interpreted in spatial competition terms as supply of HE services being perceived as close substitutes by their consumers (i.e. students) when these are provided in neighbouring provinces. There are two obvious caveat to this interpretation. The first one is that it is reasonable to consider HE institutions in nearby provinces substitutes only within the same field of study, while it seems difficult to consider e.g. a STEM faculty as a substitute of a Humanities faculty in a nearby province. The second caveat is the appropriate definition of neighbourhood. It is obviously correct to consider neighbours the provinces who share a border, as we have done up to now. However, even provinces that do not share a border can be very close to each other e.g. in terms of distance, or travel time, thus their local supply of education can be reasonably considered substitutable. We tackle these two issues in the next two subsections.

5.2   Competition Across and within field of study

In Table 5, we analyse the issue of competition in HE supply within the same field of study and between different field of studies. We group all faculties available in our sample into three major groups i.e. Humanities, Science, Technology, Engineering and Mathematics (STEM), and Social Sciences.[5] We run three sets of regressions for cross and within discipline competition in HE supply. Table 5 includes three Panels A-C, where our dependent variable is the local supply of HE in humanities, STEM, and social sciences, respectively. For each panel, we present five different specifications. In Columns [1] and [3], we perform OLS FE and 2SLS FE estimates, considering as explanatory variable the neighbour's HE supply in the own field of study. In Columns [2] and [4] we include neighbour's HE supply in the other two fields. Finally, estimates in Column [5] are identical to those reported in Column [4], but coefficients are standardized to compare the magnitudes. All specifications include province

---

[5]Humanities include education, linguistic studies, literature, and psychology. The STEM group includes agriculture, chemistry and pharmacy, geology and biology, medical studies and scientific studies. Social Sciences include architecture, economics and statistics, engineering, law, and socio-political studies.

fixed effects, region by year fixed effects, and the usual set of controls.

Results provide strong support to the view that HE supply in neighbouring provinces has a negative effect on the local HE supply within the same field of study, particularly for STEM disciplines. Estimates from Table 5 (Column 5) for STEM, suggests that in a province with 4 neighbours HE supply in STEM decreases by 1.6 faculties, when STEM HE decreases by 1 faculty in each neighbour. Conversely, there is not much evidence of any negative effect between different fields of study. These results lend support to the substitutability hypothesis of HE supply between neighbouring provinces, but only within the same field of study, while no substitutability emerge between HE institutions belonging to different fields.

6 Conclusions

In this paper, we use a own-built historical dataset on the formation of tertiary education institutions in Italy (History of Italian Universities - HIU) that includes information on higher education institutions by university major and local administrative units (provinces) to investigate spatial competition in the supply of tertiary education at the province level. More specifically, we analyse whether the existence of a higher education institution in a neighbouring province hinder the local supply of tertiary education. We also perform a separate analysis by field of studies, assessing the spatial substitutability between majors within and across different disciplines (humanities, stem, social sciences).

To this purpose, we use HIU data to create a province by year panel data and estimate a spatial competition fixed effect model in which the number of faculties in a given province is function of the faculties supplied by its neighbours. Because of spatial correlation induced by time-varying province effects and reverse causality issues, we use an IV strategy to estimate the spatial competition model, which exploits exogenous variation associated with the ?early life conditions? of the Italian education system (i.e. the supply of higher education inherited by the states pre-existing the unification of the Italian territory under a unique State) interacted with the nine comprehensive reforms that took place over the period 1861-2010.

We find evidence that reforms of tertiary education deeply shaped the patterns of the expansion of competition in tertiary education in the Italian History. Reforms seem to have differential effect depending on the field of study.

At the descriptive level we find interesting insight from HIU data: they confirm the expansion pattern of HE institutions (no. of Faculties), particularly post-WWII (OECD, 1999, 2008). The main set of estimates reveals non-negligible effect of jurisdictional competition in HE supply. On average, since 1960 each province has about 3 faculties. The average com-

petition effect is negative: on a province which has four neighbours is $-1.8 = (-0.15 * 3 * 4)$ faculties.

This negative spatial competition effect suggests that, first, each province strategically react to what happens in the neighbourhood; second, that there is substitutability between provinces in the supply of HE, as we would expect since they compete over an overlapping local demand of university education.

On the policy side, our results suggests that even in a regulated and centralised HE system such as the Italian one - and, more in general, that of many European countries - at least in part the allocations are influenced by what happens at the territorial level, on a decentralised scale.

Table 2: Competition in tertiary education: average neighbor approach

	[1]	[2]	[3]	Obs.
(a) average no. of faculties in $-i$	0.59***	–0.76***	–0.48***	11383
	(0.11)	(0.25)	(0.14)	
(b) at least one faculty in $-i$	0.31***	–0.24*	–0.21**	11383
	(0.11)	(0.12)	(0.09)	
(c) average no. faculties in $-i$ (int. margin)	1.27***	–0.86	–0.47	4064
	(0.32)	(0.53)	(0.30)	
(d) average no. of universities in $-i$	0.43***	–0.82***	–0.82***	11383
	(0.10)	(0.27)	(0.27)	
province FE	yes	yes	yes	
region-by-year FE	no	yes	yes	
provincial controls	no	no	yes	

Notes:. In Rows (a) and (c) the dependent variable is the total number of majors in province i. In Row (b) the dependent variable is a dummy equal to 1 if at least one major 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 *elite* universities, and the number of private universities in the local province. Standard errors clustered by province are reported in parentheses. Significance levels: $*: 10\%$ $**: 5\%$ $***: 1\%$.

7 Tables

Table 3: Competition in tertiary education: pairwise approach

	[1]	[2]	[3]	Obs.
(a) no. of faculties in j	0.37***	−0.14**	−0.08***	50803
	(0.06)	(0.06)	(0.03)	
(b) at least one faculty in j	0.35***	−0.07**	−0.04*	50803
	(0.06)	(0.03)	(0.02)	
(c) no. of faculties in j (int. margin only)	0.73***	−0.16**	−0.05**	22728
	(0.15)	(0.06)	(0.02)	
(d) no. of universities in j	0.25***	−0.13**	−0.13**	50803
	(0.06)	(0.06)	(0.06)	
provincial pair FE	yes	yes	yes	
region-by-year FE	no	yes	yes	
provincial controls	no	no	yes	

Notes:. In Rows (a) and (c) the dependent variable is the total number of majors active in province i. In Row (b) the dependent variable is a dummy equal to 1 if at least one major 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 *elite* universities, and the number of private universities in the local province. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table 4: Omitted neighbourhood variables and 2SLS

	[1] OLS FE	[2] 2SLS FE	[3] 2SLS FE
total no. faculties in j	−0.08***	−0.14***	−0.17***
	(0.03)	(0.05)	(0.05)
no. of universities in j	no	no	yes
Observations	50803	50803	50803
K-P rk Wald F-stat		37.35	69.18
K-P rk LM-stat (p-value)		62.28 (0.00)	66.29 (0.00)
Hansen J-stat (p-value)		8.16 (0.42)	5.40 (0.71)

Notes:. All specifications include provincial pair fixed effects, region-by-year fixed effects, and provincial controls (total number of universities, number of *elite* universities, and the number of private universities). In columns [2] and [3], the total no. of majors 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 tertiary education reforms in Italy. See Table 9 below for details. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table 5: Cross-disciplinary competition: humanities, stem, social sciences

	[1] OLS FE	[2] OLS FE	[3] 2SLS FE	[4] 2SLS FE	[5] 2SLS FE
Panel A: faculties in humanities					
faculties$_j$, humanities	−0.16***	−0.14***	−0.16***	−0.12**	−0.13**
	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)
faculties$_j$, stem		−0.01		0.05	0.09
		(0.03)		(0.11)	(0.20)
faculties$_j$, social sc.		−0.01		−0.04	−0.08
		(0.02)		(0.03)	(0.06)
K-P rk Wald F-stat			43.18	7.27	7.27
Hansen J-stat (p-value)			5.98 (0.65)	3.99 (0.68)	3.99 (0.68)
Panel B: faculties in stem					
faculties$_j$, stem	−0.16***	−0.16***	−0.21**	−0.22**	−0.40**
	(0.03)	(0.03)	(0.09)	(0.01)	(0.20)
faculties$_j$, humanities		−0.00		−0.03	−0.04
		(0.02)		(0.03)	(0.04)
faculties$_j$, social sc.		0.00		0.02	0.04
		(0.01)		(0.03)	(0.05)
K-P rk Wald F-stat			6.09	7.27	7.27
Hansen J-stat (p-value)			8.04 (0.43)	5.36 (0.50)	5.36 (0.50)
Panel C: faculties in social sciences					
faculties$_j$ social sc.	−0.15***	−0.14**	−0.18***	−0.11*	−0.22*
	(0.05)	(0.05)	(0.04)	(0.05)	(0.12)
faculties$_j$ stem		0.01		−0.29**	−0.51**
		(0.05)		(0.13)	(0.23)
faculties$_j$ humanities		−0.04		−0.02	−0.02
		(0.03)		(0.06)	(0.06)
K-P rk Wald F-stat			73.54	7.27	7.27
Hansen J-stat (p-value)			8.02 (0.43)	2.80 (0.83)	2.80 (0.83)
Obs.	50803	50803	50803	50803	50803

Notes:. In Column [3] there is one endogenous regressor i.e. the no. of majors in the respective discipline (humanities in Panel A, stem in Panel B, social sciences in Panel C), in the neighbouring province. In Column [4] there are three endogenous regressors i.e. the no. of majors 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 standardized to have zero mean and unity standard deviation. In 2SLS estimates, the instruments are interactions of initial conditions (total no. of majors in 1861) with a battery of dummies for tertiary education reforms in Italy. See Table 10 below for the first stage estimates. All specifications include provincial pair fixed effects, region-by-year fixed effects, the usual set of provincial controls for the local province and the number of universities in the neighbouring province. Standard errors clustered by province are reported in parentheses. Significance levels: $\ast : 10\%$ $\ast\ast : 5\%$ $\ast\ast\ast : 1\%$.

Table 6: HE supply In Pre-unitarian Italian States

Province	Faculties	pre-unitarian State	Province	Faculties	pre-unitarian State
Bologna	6	Papal States	Palermo	4	Kin. of two Sicilies
Cagliari	4	Kin. of Sardinia	Padova	4	Lombardy-Venetia
Caserta	1	Kin. of two Sicilies	Perugia	2	Papal States
Catania	4	Kin. of two Sicilies	Pisa	6	Gran Duchy of Tuscany
Ferrara	4	Papal States	Parma	5	Duchy of Parma
Genova	5	Kin. of Sardinia	P.Urbino	2	Papal States
Macerata	3	Papal States	Pavia	5	Kin. of Sardinia
Messina	3	Kin. of two Sicilies	Roma	5	Papal States
Milano	2	Lombardy-Venetia	Siena	2	Gran Duchy of Tuscany
Modena	4	Duchy of Modena	Sassari	3	Kin. of Sardinia
Napoli	6	Kin. of two Sicilies	Torino	8	Kin. of Sardinia
			Trieste	1	Austrian Empire

Notes:. HE supply refers to the last year of existence of the Pre-unitarian state before it was annected to the Italian Kingdom. This is 1859 for all states reported with the exception of the Papal States (1870), Lombardy-Venetia (1866), Austrian Empire (1927).

Table 7: List of higher education reforms 1870-2010

R.D. 2102/1923:	HE liberalisation; institution of "free", 1st-tier vs. 2nd-tier univ. scientific character of HE; creation of new faculties (e.g. political sciences).
R.D. 1592/1933:	HE "nationalization"; free univ. become UdS, all schools become Faculties (e.g. agricultural studies).
Law 910/1969:	liberalization of study plans; more flexibility in the curricula
Law 766/1973:	opening new faculties, increase in the number of university teachers
D.P.R. 382/1980:	re-organization of internal governance (departments, councils); recruitment and career of university teachers;
Law 168/1989:	creation of MURST; triennial development plans; institutional, administrative autonomy
Laws 245-341/1990:	new triennial development plans; reorganization of teaching and curricula;
Law 59-127/1997:	university deregulation; more financial and teaching autonomy; physical division of mega-universities; development/planning/assessment of HE system;
D.M. 509/1999:	3+2 degrees, liberalisation of curricula; internal organisation

Source: Eurydice (1999).

References

Braga, M., Checchi, D., and Meschi, E. (2013). Educational policies in a long-run perspective. *Economic Policy*, 28(73):45–100.

Brekke, K. R., Siciliani, L., and Straume, O. R. (2015). Hospital Competition with Soft Budgets. *Scandinavian Journal of Economics*, 117(3):1019–1048.

Hoxby, C. and Turner, S. (undated). Expanding College Opportunities for High-Achieving, Low Income Students. Technical report.

Schtz, G., Ursprung, H., and Woessmann, L. (2005). Education Policy and Equality of Opportunity. Technical report.

Valero, A. and Reenen, J. V. (2016). The Economic Impact of Universities: Evidence from Across the Globe. NBER Working Papers 22501, National Bureau of Economic Research, Inc.
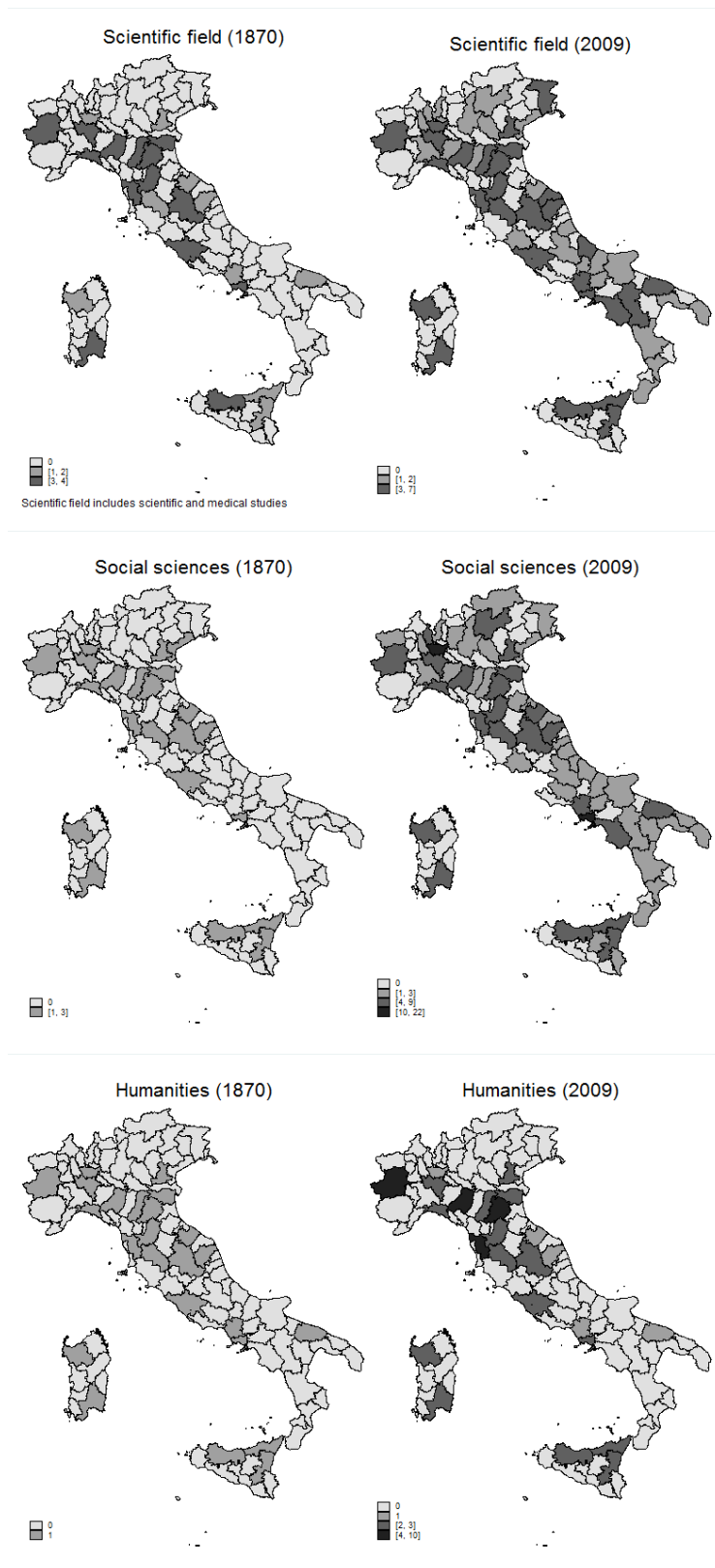
A   Appendix

Figure 5: Diffusion of majors in Italy

Table 8: Number of Majors in Italy between 1870 and 2009

Major	1870	2009
1. HUMANITIES	16	127
Education	1	34
Linguistic	1	24
Literature	12	54
Psychology	2	15
2. SCIENTIFIC AND MEDICAL ST.	62	158
Agriculture	9	37
Chemistry&Pharmacy	18	31
Geology&Biology	1	3
Medical studies	19	39
Scientific studies	15	48
3. SOCIAL SCIENCES	31	238
Architecture	3	23
Economics&Statistics	1	68
Engineering	5	44
Law	21	55
Socio-political studies	1	48

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

Table 9: APPENDIX Initial conditions, tertiary education reforms and majors' supply in neighboring provinces

	[2] IV FE	[3] IV FE
(IC_j)*(R.D. 2102/1923)	0.20***	0.11***
	(0.05)	(0.04)
(IC_j)*(R.D. 1592/1933)	0.14***	0.10***
	(0.03)	(0.03)
(IC_j)*(L. 910/1969)	0.24***	0.22***
	(0.02)	(0.02)
(IC_j)*(L. 766/1973)	0.06***	0.05***
	(0.02)	(0.02)
(IC_j)*(D.P.R. 382/1980)	0.05	0.05***
	(0.03)	(0.02)
(IC_j)*(L. 168/1989)	0.04**	0.04***
	(0.01)	(0.01)
(IC_j)*(L. 245/1990)	0.19***	0.21***
	(0.05)	(0.04)
(IC_j)*(L. 59/1997)	0.19***	0.17***
	(0.03)	(0.02)
(IC_j)*(D.M. 509/1999)	0.09***	0.11***
	(0.03)	(0.03)
R squared	0.91	0.96
Observations	50803	50803
no. of universities in province j	no	yes

Notes:. First stage of IV FE estimates reported in Table 4. 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 10: APPENDIX Initial conditions, tertiary education reforms and majors' supply by discipline

	humanities	stem	social sciences
(IC_j)*(R.D. 2102/1923)	−0.001	0.028**	0.082***
	(0.012)	(0.013)	(0.024)
(IC_j)*(R.D. 1592/1933)	0.022***	0.025**	0.056***
	(0.007)	(0.011)	(0.019)
(IC_j)*(L. 910/1969)	0.054***	0.015***	0.155***
	(0.012)	(0.005)	(0.011)
(IC_j)*(L. 766/1973)	0.002	0.012**	0.034***
	(0.003)	(0.005)	(0.012)
(IC_j)*(D.P.R. 382/1980)	0.003**	0.012*	0.034***
	(0.00)	(0.007)	(0.012)
(IC_j)*(L. 168/1989)	−0.007**	−0.004*	0.048***
	(0.003)	(0.002)	(0.009)
(IC_j)*(L. 245/1990)	0.078***	0.021***	0.106***
	(0.015)	(0.007)	(0.027)
(IC_j)*(L. 59/1997)	0.106***	−0.003	0.063***
	(0.011)	(0.005)	(0.019)
(IC_j)*(D.M. 509/1999)	0.054***	0.008*	0.048**
	(0.014)	(0.004)	(0.019)
R squared	0.87	0.97	0.92
N	50803	50803	50803

Notes:. First stage of IV FE estimates reported in Table 5. 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: $*: 10\%$ $**: 5\%$ $***: 1\%$.