Selecting University Professors in Italy: much 'ado' about nothing?*

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Abstract

The aim of this paper is assessing the effects of decentralizing recruitment procedures on the average quality of promoted professors in the Italian academia. Quality is measured via some bibliometric indicators obtained from the web version of ISI Web Of Knowledge over the last two decades (1991-2010). We find negative effects of decentralisation on international research quality of promoted researchers in terms of quantity, impact and notoriousness of their published research products. This result is confronted with changes in promotion criteria adopted by national and local selection committees. We find contrasting results: an overall general worsening effect of decentralization on the quality of recruited is not clearly identified. However differentiating our analysis by disciplinary area we find negative effects in hard sciences (especially in Physics, Chemistry and Biology). A general increase in the variability of research outcomes of promoted professors and a polarization in selecting criteria are associated with the decentralisation reform (where better candidates are more likely to be selected into higher quality departments with respect to national competitions). The absence of coherent results suggests that selection criteria remain independent from the level of selection

JEL Classification: I28, J45

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> I had been proposing a favorite thesis that our universities are run in reverse. While a man is still young and energetic and curious, he is required to teach so many elementary courses and read so many examinations - and scrub so many floors at home - that he can do no research. Even his summers must be spent earning more money. When he gets older, his teaching load is cut in half and his paper work is delegated to assistants - and his salary doubles. But now he is usually beyond creative work, and develops his bridge or golf.
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> G.Stigler, An academic episode, 1947

1. Introduction

The main aim of the present paper is to analyse whether recruitment mechanisms of academic professors matter for the quality of selected scientists (Allesina, S., 2011; Checchi, D., 1999). More specifically in what follows we aim to assess whether the decentralisation of recruitment procedures at local university level introduced more than a decade ago in Italy (Berlinguer's reform in 1998) has modified the research ability of both selected associates and full professors (Levin, S. 1991 and Noser et al. 1996). In order to conduct this investigation, we build up a new dataset of international research outputs for Italian professors over the period 1991-2010 thanks to the web version of ISI Web of Knowledge, which is then matched to the individual administrative archive of Italian university professors (assistant, associate and full) handled by the Italian Ministry of University and Research (MIUR). The final database contains 963.181 records of published articles in scientific journals by Italian academics over the last twenty years. Some bibliometric measures of research productivity (mainly on quantity, notoriousness and impact of the published research) are calculated for each professor over the sample period.

While the issue of familiar networks and its relations with labour market outcomes, wages and school enrolment has been recently studied (e.g. Angelucci et al, 2010), less attention has been devoted to recruitment reforms (Fox, M. F., 1983). According to our knowledge only the paper by Durante et al. (2011) explores the effects of this decentralizing reform on recruitment procedures in terms of increasing nepotism and familism phenomena. The authors find evidences of higher probability of these misbehaviours in those territorial areas where a lower level of civic capital is present. According to our knowledge no other papers have studied the implications of *changing the level of selection on the quality of the selected*. This is crucial considering that the Italian University system is at the eve of another reform of recruitment procedures, which goes in the opposite direction of recentralising again the procedures.

The paper is structured as follows: the next section introduces background information about the Italian academic system, while the third one discusses the issue of quality measurement using bibliometric indicators and provides descriptive statistics regarding Italian professors. In section 4 we contrast the two different recruitment procedures (local and national) in terms of relative probability of career advancement, while in the subsequent section 5 we present both the empirical strategy and results obtained when testing the potential differences between professors selected before and after the. In section 6 we then move deeper in the analysis of the selection processes focussing on changes in the determinants of being selected within each of the two regimes. Conclusions and policy issues complete the paper.

2. The Italian Academic System

The Italian university system is made by 89 universities (61 public and 28 private) and 6 higher education institutions. The latter offer masters and PhD courses only, being more research oriented than most universities. Three among public universities are polytechnics, while 11 out of the 28 private institutions are distance-learning universities. At the end of year 2012, the overall university

system is employing 57305 professors and an equivalent number of non teaching staff (56653), and is offering course to 1751186 students enrolled in undergraduates or postgraduate studies.

The Italian university system is regulated by national rules and by local statutes, but recruitment procedures, employment conditions and salaries fall under the control of nation-wide norms. Each professor working at an Italian university is characterised by a level of arrangement (full professor, associate professor or assistant professor) and by one research field (*settore scientifico-disciplinare*).[1] Research fields are defined according to homogeneity of research topics. To give an example within the economic area, research fields are economics (*economia politica*), economic policy (*politica economica*), public economics (*scienza delle finanze*), history of economic thought (*storia del pensiero economico*), econometrics (*econometria*) and applied economics (*economia applicata*). This partition does not necessarily follow rational rules, nor they do adjust to the evolution of research; rather, they do reflect past allocations of positions as well as strategies to hold controls of new promotions. In facts, any vacancy is coded by research field, and applicants are to be evaluated by professors of the same field. Once a position is filled, it becomes tenured after a review conducted three years later (once again by professors of the same research field). Since there are teaching obligations, each position is also associated to a school (*facoltà*), which also select the course to be taught (again, within the same research field). Recent attempts to relax the tie between professors and research fields (by aggregating similar research fields) have proved difficult to operate, due to the opposition of factions of the academia.

Salaries in public universities are set by law and vary only by seniority and level of arrangement. Schools and departments are prevented from differentiating wages among professors, linking payment to research productivity and/or teaching loads. As a consequence, in addition to fame and funds attraction, the strongest incentive to scientific productivity for researchers derives from the expectation of future promotions. Given the public nature of the employment contracts, university professors can only be hired through public competitions that should grant publicity of the vacancy, selection of the selecting committee based on objective criteria, transparency of the selection process. This explains why the institutional design of selection procedures is crucial for their future impact on research productivity and quality.

Since 1979, centrally managed nation-wide competitions were the main channel used to hire associate and full professors.[2] Despite the legislative prescription of holding one competition (*concorso*) for each research field and for each level of assignment every two years, a three to four years interval actually occurred. National committees of five to nine members (conditional on the number of received applications) were formed from the pool of professors belonging to the same research field. Commissioners selected the candidates qualified to be promoted associate or full professors. Given the final list of eligible candidates, a multilateral bargaining between them and the universities with openings lead in a relatively short period of time to the identification of who was hired where.

In 1998 a radical reform was introduced in the selection procedure (DPR n.390, issued in October 1998). Pressed by a rising demand for tertiary education, the government in office realised that the

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[1] There are currently 372 research fields, grouped into fourteen research areas, as designated by the Italian National University Council (CUN). The research areas are identified by a numerical index (in brackets the number of professors classified in each of them): 1.Mathematics and Computer Sciences (3178), 2.Physics (2225), 3.Chemistry (2913), 4.Earth Sciences (1056), 5.Biology (4857), 6.Medicine (9862), 7.Agriculture and Veterinary Sciences (3032), 8.Engineering and Architecture (3572), 9.Industrial Engineering and ICT (5292), 10.Humanities (5189), 11.History, Philosophy and Psychology (4774), 12.Law (4831), 13.Economics and Statistics (4785), 14.Sociology and Political Sciences (1739).

[2] An alternative channel was offered by hiring foreign professors who have given relevant contributions to the discipline (known as "*clara fama*", which can be translated as "unquestionable reputation"), but it was conditional on the formal approval of the Ministry of University. Vice versa, assistant professors have always been hired through local competitions, where the selecting committee was appointed by the central government.

ongoing system of centrally organised competition would have been unable to adjust the hiring of new professor to the accelerating enrolment of students. Starting in 1999, recruitment procedures became entirely local, and each university could hold its own selection procedure for assistant (which were already hired through local competition, however managed by centrally formed committees), associate and full professors. Local committees comprised five members, one of which directly appointed by the local university (the so-called 'internal commissioner') and the remaining four being elected by the pool of Italian professors in the same research field (each professor was eligible once a year, but has the right to vote for each competition).[3] The selected committees appointed up to three qualified candidates (qualifications were reduced to two between 2007 until 2008, and to one thereafter). In the ensuing five years, universities could hire any qualified candidate as professors.

Given the delay in the implementation of the decentralisation reform, professors qualified under the new selection procedure started to be hired during the year 2000, two years after the enactment of reform (also known as Berlinguer's reform, from the name of the Minister then in office). Consequently, our empirical analysis marks the beginning of decentralization from that year. This reforms changed pre-existing procedures with respect to at least three dimensions:

1) moving the *level of selection* from national to local affected the number of potential applicants,[4] but also the frequency of the selection due to the lighter bureaucratic load associated to a local competition; in addition, lighter procedures allow for more frequent opening of vacancies.

2) *easier selection of selecting committees* at local level. When competitions were operated at national level, committees were formed combining randomness and elections,[5] while at local level committees were simply elected (at least up to 2010) by the existing body of university professors belonging to the same research field.

3) the *number of available positions per competitions was increased*. Under the national system, each vacancy allowed for one single hiring, and therefore competition among candidates was fiercer since the number of promoted professors could not exceed the number of available vacancies. On the contrary, each local competition was entitled to assign up to three qualifications[6] (*idoneità*) which entitled the qualified candidate to be hired as professor by any university in the following five years.

The combination of these three elements suggests that *national competitions were perceived as higher stakes*; as a consequence selecting committees were put under harder pressures, because of higher visibility and fiercer competition among candidates. On the contrary, *local competitions allowed for greater autonomy in recruiting* by local universities, which could have opened the door to arbitrariness and nepotism (Durante et al. 2011) but also to local excellence.

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[3] Given the ease of manipulation, more recently (2010) a new reform act established that the committee members are to be randomly drawn from the pool of professors.

[4] In competitions for associate or full professorships, candidates were entitled to apply only to 5 local competitions per year, thus reducing the potential applicant per competition.

[5] More precisely, in competitions for full professorships full professors elected a triple number of potential commissioners, among which the actual members were randomly drawn. On the contrary, in competitions for associate professorships (which were probably deemed less relevant from a strategic point of view) a triple number of potential commissioners were randomly drawn from the universe of full and associate professors, which then voted over these members.

[6] Given the explosion of promotions originating by this procedure, the number of qualification was later on reduced to two.

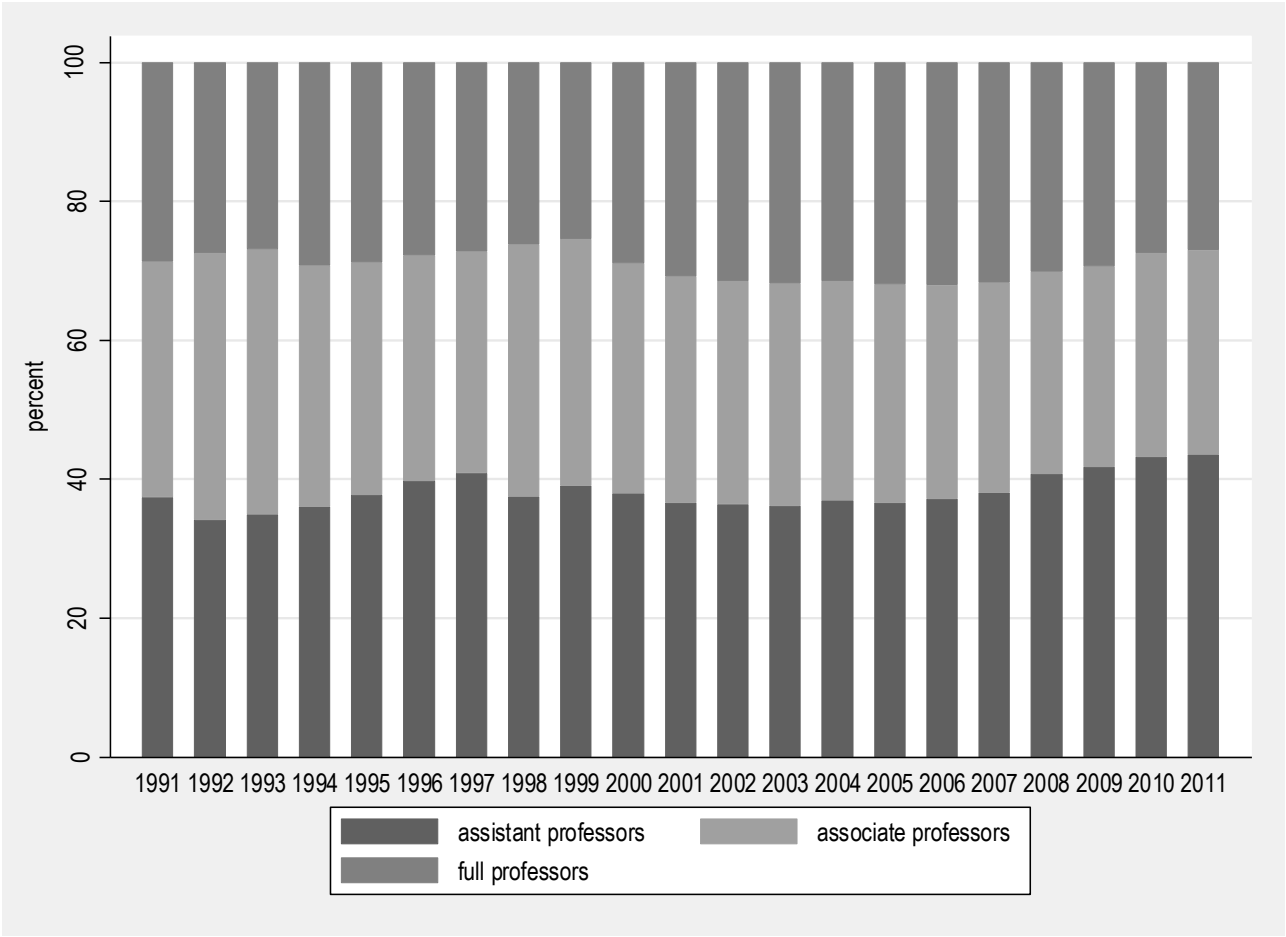


Figure 1: Share of Italian professors by academic rank and year

3. Measuring the quality of professors by means of bibliometric indices

University professors perform different tasks, the main ones being teaching (at both undergraduate and postgraduate level), research and administration. The quality of the performance in each task is difficult to measure because of unobservability of individual effort and talent, and university administrators (deans, provosts, rectors) are to rely on observable proxies, corresponding to the outputs of these activities.

Quality of undergraduate teaching is difficult to measure, since the final outcome (typically in terms of future wage and/or employment prospect) is often the joint result of the joint effort by faculty members. In principle one could exploit variations in the exposure to different teachers to indentify the individual contribution (as done by Braga et al. 2011). However the students' assessment is often plagued by exogenous source of variations (like gender, age, ethnicity of both the instructor and the students), and it is not always possible to account properly for it. As far as postgraduate teaching, the quality of supervisors can be indirectly measured by research output of a supervisee, even if again confounding factors should be appropriately accounted for (in particular considering self-sorting of students into universities, as well as journal networks)

Quality in research can be measured by different indicators: publications, citations, funding, membership in editorial boards, academic prizes. All these variables are potentially correlated, and are available at different degrees in different subjects and countries. In the sequel we propose the use of bibliometric measures from the web version of ISI (Klavan and Boyak, 2007), since it dispenses of subjective judgments of the scholar, and it benefits from the property of cardinality (and therefore is interpersonally comparable, at least within the research field).

We are fully aware of the potential limits of a bibliometric approach (Seglen, 1997). In facts its main drawbacks consist of:

a) it relies on the existence of large database, which are typically only available for large academic communities, open to international competition;

b) as a consequence, it penalises national academic communities, which often write in their native languages and are not necessarily open to English writing and publishing;

c) we are also aware that the diffusion of the use of bibliometric indicators in the process of research assessment induces mainstream compliance in the research community, in the attempt to publish in top journals of each research field (Baccini 2010).

Nevertheless we hold the view that the pros exceed the cons in the present case, at least for scientific communities which are open to international competition. Therefore we proceed with the use of bibliometric analysis for the Italian academic communities where we deem it applicable.

Let us start presenting our main output variable, which consists of the number of ISI-Web of science (hereafter WoS) records associated to each professor (assistant, associate or full) working in the Italian academia over the sample period (1991-2010).[7] In table 1 we report the number of professors by assignment and their presence in the ISI-WoS database, while in table 2 we show their yearly productivity. The two tables give us a clear picture that the Italian academy has experienced a rising trend in productivity recorded in WoS over the last 20 years. This creates two orders of problems in our following analysis:

i) our measures of productivity are clearly trended, and this may not be only the reflection of Italian professors doing more research, but simply the result of WoS extending its coverage over scientific journals;

ii) some research areas do publish in journals that are not surveyed in ISI-WoS and for this reason they are excluded by construction.

[we should include descriptive statistics on the output variables]

Table 1 - Professors and ISI web of science publications

year	assistant professors (ricercatori)	associate professors (associati)	full professors (ordinari)	total professors	% assistant professors with one ISI record	% associate professors with one ISI record	% full professors with one ISI record	% total professors with one ISI record
1991	16184	14715	12431	43330	26.58	29.91	32.23	29.33
1992	15514	17517	12500	45531	28.81	35.42	37.30	33.68
1993	16319	17883	12582	46784	32.09	38.91	40.85	37.05
1994	17329	16680	14071	48080	35.30	41.30	44.26	40.00
1995	18636	16538	14286	49460	38.37	43.93	46.88	42.69
1996	19618	16114	13737	49469	40.90	46.54	49.65	45.17
1997	20099	15683	13405	49187	43.57	49.31	52.47	47.83
1998	18745	18108	13103	49956	45.00	52.74	55.52	50.57
1999	19803	18058	12906	50767	46.74	54.57	57.36	52.22
2000	19704	17256	15030	51990	47.52	56.03	58.95	53.65
2001	20087	17876	16891	54854	48.45	56.91	60.65	54.96
2002	20887	18497	18134	57518	49.31	58.20	61.51	56.02
2003	20407	18093	17960	56460	53.51	60.04	62.95	58.60
2004	21175	18108	18084	57367	54.47	61.27	64.19	59.68
2005	22007	18965	19277	60249	54.19	61.63	65.14	60.04
2006	23053	19087	19853	61993	54.83	62.70	66.40	60.96
2007	23558	18735	19625	61918	57.40	64.16	67.46	62.63
2008	25587	18257	18938	62782	58.12	65.78	68.92	63.60
2009	25425	17567	17878	60870	61.11	67.68	70.35	65.72

[7] Details on the construction of this database can be found in the third chapter of Verzillo (2013).

2010	24940	16953	15851	57744	62.83	69.49	71.70	67.22
2011	24596	16618	15244	56458	64.09	70.60	72.65	68.32
					49.24	55.00	58.92	53.94

Table 2 - Average yearly productivity by level of appointment – ISI-WoS publications

	assistant professors (ricercatori)	associate professors (associati)	full professors (ordinari)	total of professors
1991-2	0.438	0.595	0.796	0.602
1992-3	0.501	0.633	0.889	0.659
1993-4	0.531	0.607	0.939	0.680
1994-5	0.604	0.669	0.993	0.742
1995-6	0.681	0.735	1.090	0.815
1996-7	0.711	0.775	1.159	0.856
1997-8	0.721	0.867	1.223	0.910
1998-9	0.769	0.891	1.239	0.937
1999-0	0.775	0.875	1.284	0.962
2000-1	0.826	0.988	1.410	1.074
2001-2	0.818	1.021	1.436	1.093
2002-3	0.900	1.082	1.498	1.149
2003-4	0.952	1.152	1.562	1.216
2004-5	0.953	1.231	1.658	1.285
2005-6	1.027	1.305	1.785	1.371
2006-7	1.133	1.418	1.911	1.473
2007-8	1.186	1.485	1.941	1.514
2008-9	1.387	1.707	2.207	1.723
2009-10	1.319	1.691	2.200	1.677
2010-11	1.286	1.592	2.066	1.594
average	0.915	1.073	1.512	1.148

For these reasons, we have decided *to set a minimum threshold of diffusion in each research area*: we consider the measure from ISI-WoS as significant for scientific productivity only when the coverage exceeds a minimum threshold of 50%. Looking at table 3 we see that only eight research areas satisfy this requirement, and we will mainly focus on them. They do correspond to the bulk of hard sciences, whereas soft sciences remain in the background.

Table 3 – ISI-WoS publications by research areas (*aree CUN*)

Research area (*aree CUN*)	% total professors with one ISI record
1.mathematics and computer sciences (*scienze matematiche e informatiche*)	71.60
2.physics (*scienze fisiche*)	84.79
3.chemistry (*scienze chimiche*)	89.03
4.earth science (*scienze della terra*)	67.05
5.biology (*scienze biologiche*)	82.31
6.medicine (*scienze mediche*)	75.80
7.agriculture and veterinary science (*scienze agrarie e veterinarie*)	64.50
8.engineering and architecture (*ingegneria civile e architettura*)	30.42
9.industrial engineering and ICT (*ingegneria industriale e dell'informazione*)	75.54
10.humanities (*scienze antichita, filologico-letterarie e storico-artistiche*)	17.74
11.history, philosophy and psychology (*scienze storiche, filosofiche, pedagogiche, psicologiche*)	28.34
12.law (*scienze giuridiche*)	12.50
13.economics and statistics (*scienze economiche e statistiche*)	32.91
14.sociology and political science (*scienze politiche e sociali*)	22.26
missing	27.91
Total	53.94

4. National versus local competitions

Given the possibility of measuring scientific productivity as proxy for unobservable ability of researcher, we aim studying *whether moving from a centralised to a decentralised selection procedure changes the quality of candidates eligible for professorship*. We study the quality of the selections under two alternative systems: *national competitions*, employed until the year 2000 and consisting of two waves for associate professorship, concluded in 1992 and 1998, and one wave for full professorship, which ended in 1995; and *local competitions*, held almost twice a year and granting three (later two) qualifications for each competition.

Unfortunately we do not have detailed information on all competitions, either under the national or the local system. We just observe changes in the level of appointment that cannot be but the result of a public competition, since public universities are prevented from hiring or firing at will. An exception is represented by appointment of professors from foreign universities, which did not require participation to a national or a local competition. Thus the most appropriate definition of our study object would be *promotions under a national/local competition system*. The number of such promotions is reported in table 4. Despite being selected under different selection procedures, either national or local, any qualified candidate has to be selected by a local school/department in order to be hired. As a consequence, *our analysis provides information on the quality of the recruitment in the Italian universities over the last two decades*.

The most sizeable groups are represented by the transitions from assistant to associate professor and from associate to full professor (grey columns), and we will focus on them. There is an additional justification to leave the transitions from outside to professorship in an Italian university out of our analysis: since these candidates were previously working in a non-Italian university, we are unable to match them to any previous publication. In addition, we ignore the size of the pool of potential applicants for this type of promotions. Finally, this channel of recruiting received direct funding from the Ministry of Education of varying size over the years, following a request of local university and a check of subsistence of requirement of '*clara fama*'.

Table 4 - Promotions of Italian professors

year	from assistant to associate	from outside to associate	from associate to full professor	from assistant to full professor	from outside to full professor	overall transitions
1991	83	43	149	11	17	303
1992	2118	746	56	1	12	2933
1993	248	181	60	3	20	512
1994	90	64	1354	68	67	1643
1995	30	15	182	21	12	260
1996	36	26	52	6	11	131
1997	53	13	26	16	23	131
1998	2322	438	41	3	15	2819
1999	447	106	229	4	2	788
2000	1693	372	2443	77	47	4632
2001	2757	509	2191	80	48	5585
2002	2167	488	1599	37	106	4397
2003	387	33	355	3	9	787
2004	813	193	577	6	25	1614
2005	2289	624	1614	30	42	4599
2006	1390	330	1093	11	46	2870
2007	430	133	360	4	33	960
2008	182	80	150	3	15	430
2009	29	14	28	1	7	79
2010	663	71	290	3	12	1039
2011	948	99	620	11	15	1693
Total	19175	4578	13469	399	584	38205

A final *caveat* concerns the number of promotions available. A quick inspection of table 4 reveals that more openings were available in the second sub-period (local system) when compared to the first one (national system). However, what matters for a promotion is the relative odd. In figures 2 and 3 we show the ex-ante probability of being promoted, taking the ratio between the type of transitions (given in table 4) and the number of potential applicants (given by the stock of starting number of professors, given in table 1). Again by visual inspection, one may ascertain that the odds of being promoted are comparable across the two sub periods.

Summing up, in the sequel we will analyse the research productivity (as measured by ISI-WoS records) of promoted professors in several research areas (*area CUN* from 1 to 7 and 9, see table 3 – using a more recent bureaucratic language, these are indicated as "bibliometric areas"), comparing those promoted before and after the year 2000. *This comparison provides an evaluation of the two-selection procedure, national versus local.*

5. The average quality of the promoted candidates

We start by providing some descriptive evidences of the distribution of the available measures of research outputs. By looking at figures 4, 5 and 6, we observe that researchers promoted to professors are more productive in the second sub-period, at least when we consider their number of ISI record. Since the distribution of our measures of scientific productivity is rightly skewed, we consider the logs in order to show that they tend to a log-normal distribution. By so doing, we leave out of the graphs the candidates with zero publication records in ISI-WoS.

Since we know that presence in WoS is increasing over the years, figures 4 to 6 provide a lower bound estimate of the distance between the two distributions. While notoriousness (measured by the number of citations received by their articles) augment, the impact factor (measured by the average impact factor of the journals where the articles were published that year) does not exhibit significant changes over the two periods.

Table 5 - Probability of having at least one ISI product, conditional on level of appointment - linear probability model

	1	2	3
	assistant professors	associate professors	full professors
age	-0.00202***	-0.00684***	-0.00494***
	[0.000]	[0.001]	[0.001]
female	-0.00676	-0.02148***	-0.04787***
	[0.005]	[0.006]	[0.008]
reform	-0.05527***	-0.04297***	-0.03386***
	[0.004]	[0.004]	[0.004]
trend	0.02497***	0.03183***	0.03131***
	[0.001]	[0.002]	[0.002]
reform×trend	-0.00890***	-0.01542***	-0.01529***
	[0.001]	[0.002]	[0.002]
mover	-0.00718	0.03214***	0.00672
	[0.014]	[0.009]	[0.010]
mover×trend	0.10544***	0.00324	-0.00518
	[0.021]	[0.013]	[0.017]
Observations	433278	366175	330305
R^2	0.364	0.357	0.337

* significant at 10%; ** significant at 5%; *** significant at 1%
standard errors clustered by research field (ssd) in brackets - area and region controls included

Our data appearing in WoS are clearly trended, as clearly detectable in table 5. If we estimate a linear probability model of the type

$$y_{it} = \alpha_0 + \alpha_1 \cdot TREND + \alpha_2 \cdot REFORM + \alpha_3 \cdot TREND \cdot REFORM + \alpha_4 \cdot x_i + \varepsilon_{it} \qquad (1)$$

where $y_{it} = 1$ when professor i has at least one ISI record, we see that the number of professors satisfying this condition is increasing (the coefficients of *TREND* is positive), but at a lower rate (the variable *REFORM* contains a step-dummy assuming a unitary value with the year 2000 – the negative sign for the interaction between *REFORM* and *TREND* measures the extent of this decline). Being a mover (people that moves from one university at time *t* to another at time *t+1*) pays 3.2% more in the probability of having at least one ISI record respect to a stayer for associate professors only. A 10% increase in the probability is associated at being a mover assistant professor in the reformed system (local) while no effects at all are detectable for full professors.

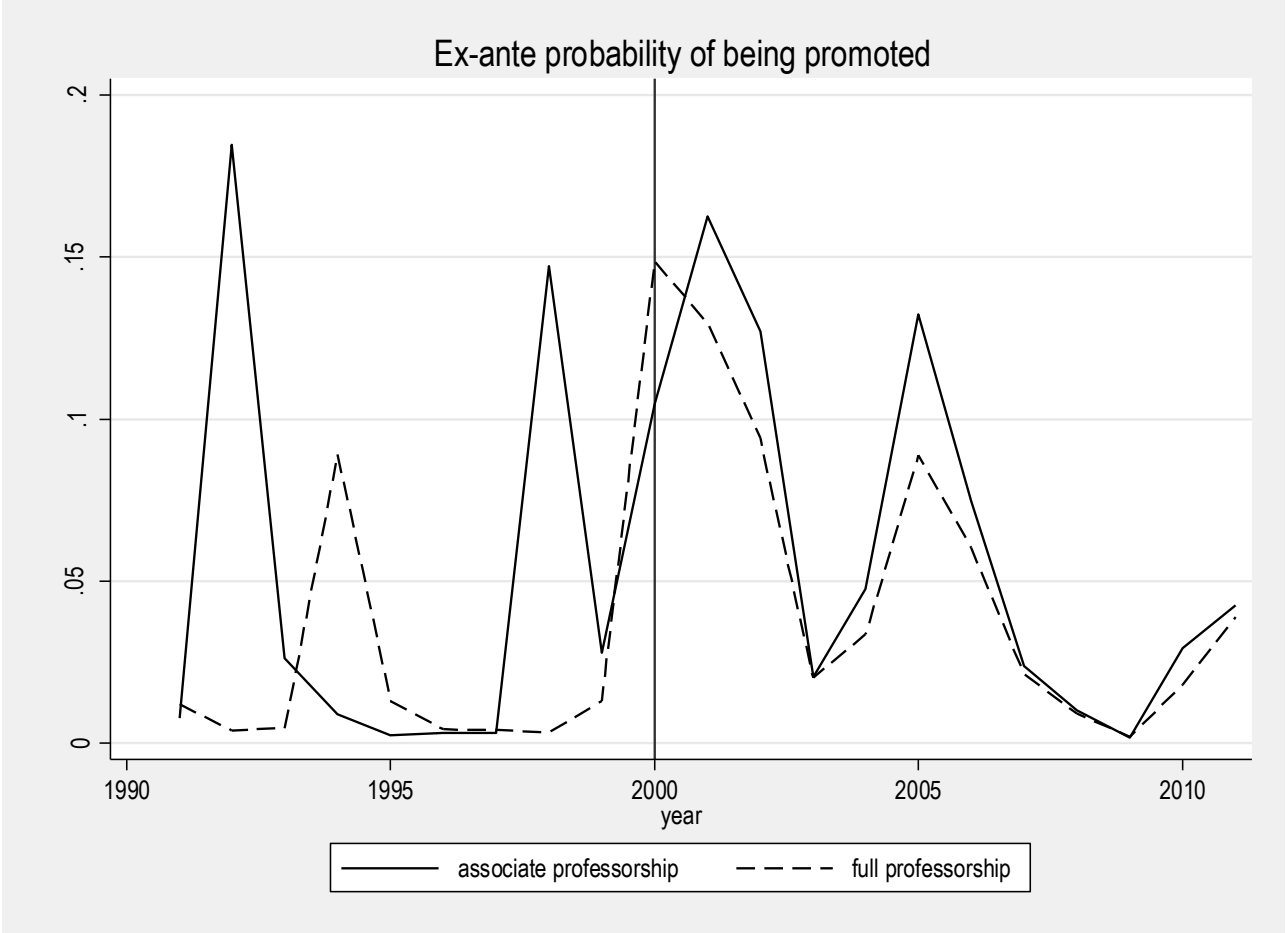


Figure 2 – Promotions over potential applicants, by type of transitions

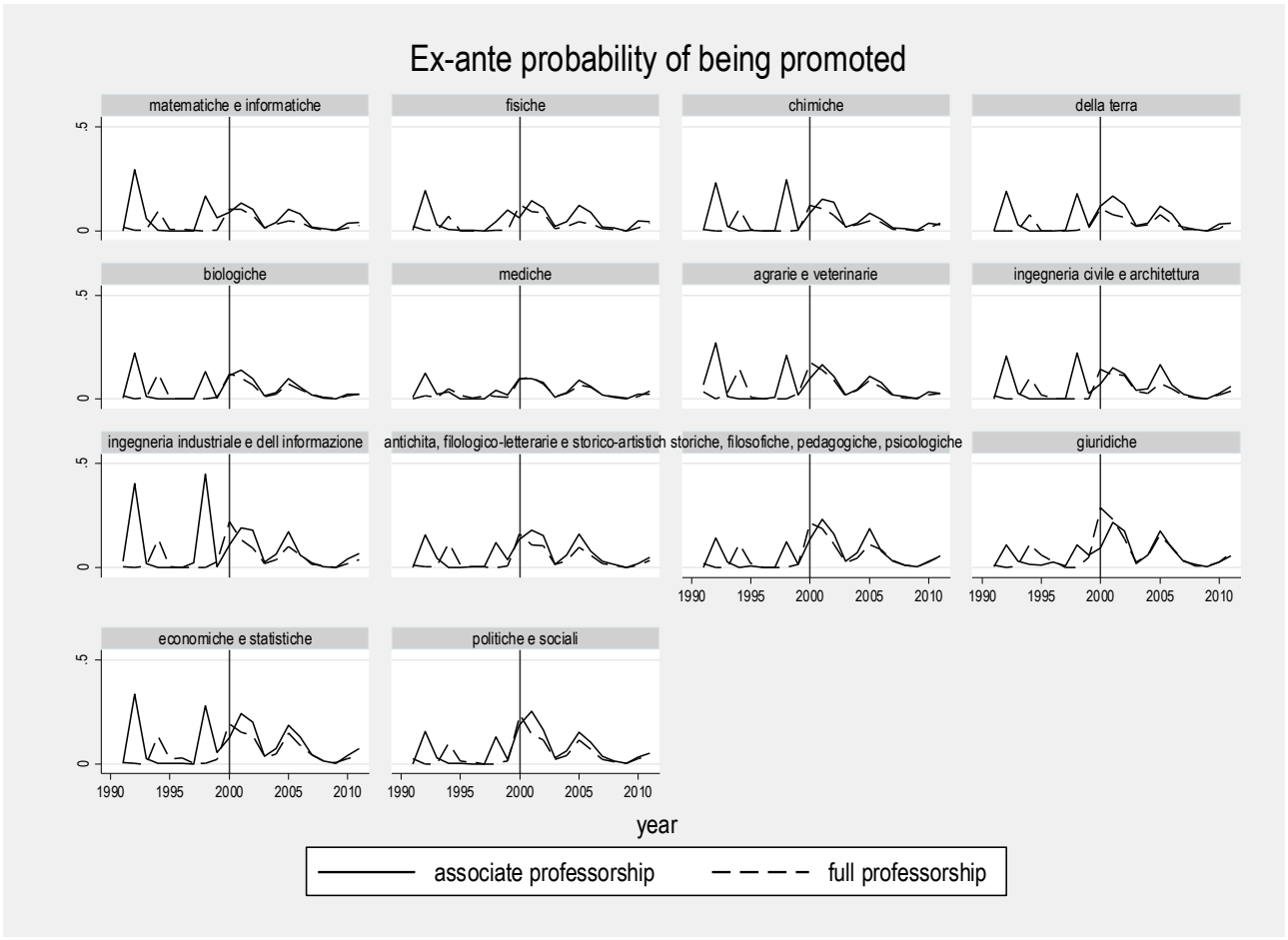


Figure 3 – Promotions over potential applicants, by research area

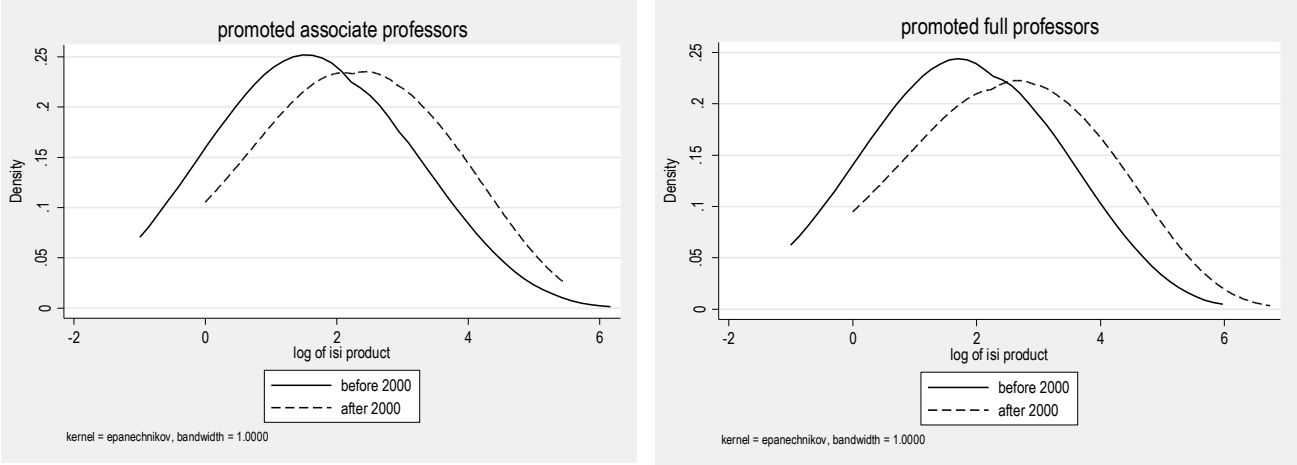


Figure 4 - Scientific productivity of promoted professors

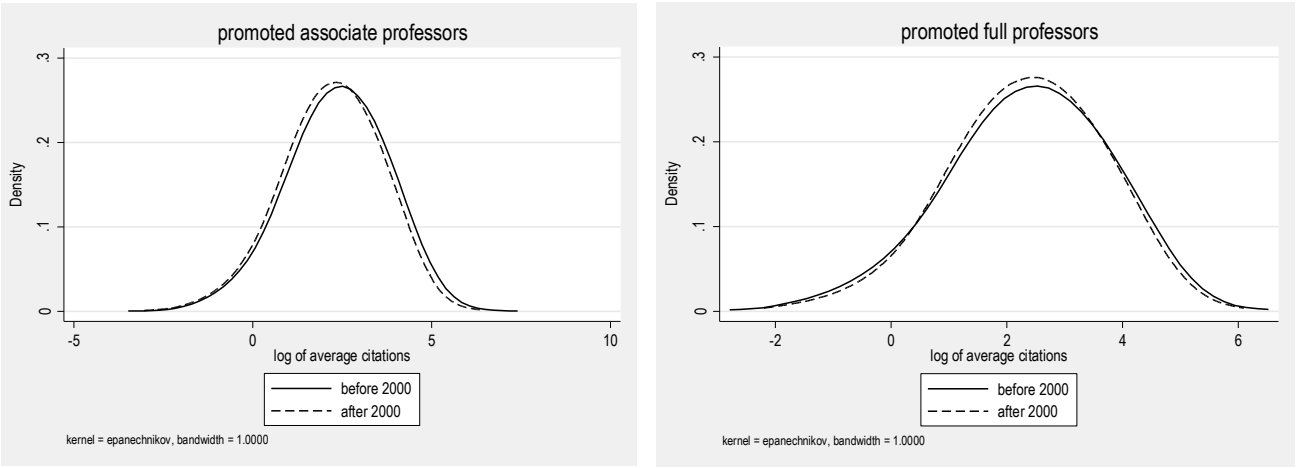


Figure 5 - Citations received by promoted professors

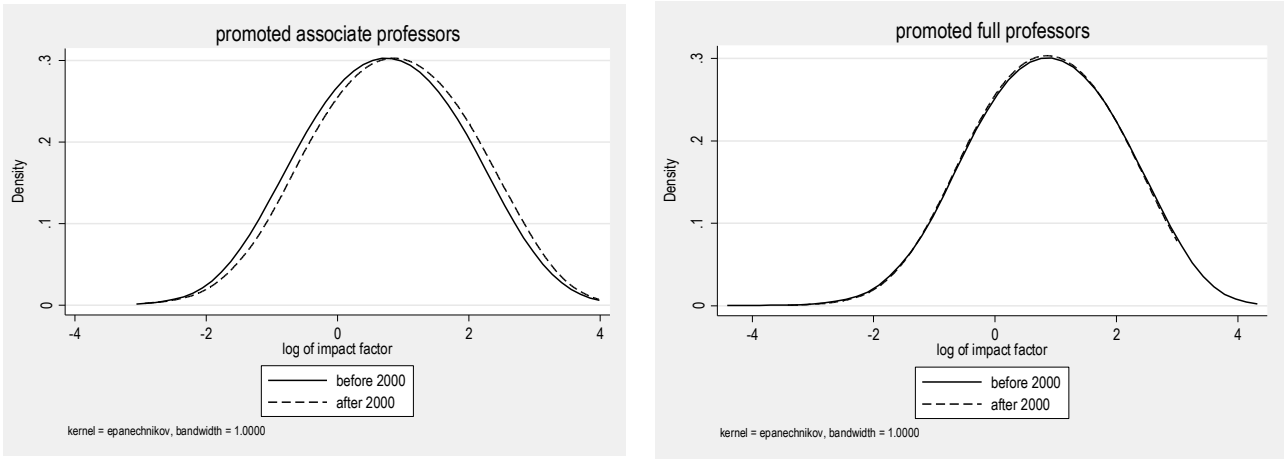


Figure 6 - Average impact factor of promoted professors

We clearly need to identify a reference level, in order to de-trend our measures. If we take the pool of applicants as our benchmark, we can compute the following measure of the quality of the promotions

$$q_{ijt} = \frac{y_{ijt}^{promoted}}{\frac{1}{n_j} \cdot \sum_{k=1}^{n_j} y_{kjt}^{non\ promoted}}$$

where q_{ijt} is the relative quality of candidate i promoted in research area j at time t, computed as the ratio of individual publications record over the (equivalent) average record of all researchers in the same research field who are not promoted in the same year.[8] *Thus all assistant professors represent the counterfactual for promoted associate professors, and similarly do associate professors for promoted full professors.*

The variable q_{ijt} is invariant to any general trend in scientific productivity, seen as a tide that raises every boat. Its interpretation is intuitive: it measures the (mean) relative distance in productivity between a promoted professor and the pool of applicants. A rise in the variable would suggest an improvement in the quality of qualified, while a decline would imply the opposite.

We then replicate previous strategy by estimating

$$q_{ijt} = \alpha_0 + \alpha_1 \cdot TREND + \alpha_2 \cdot REFORM + \alpha_3 \cdot TREND \cdot REFORM + \varepsilon_{ijt}, \forall j = 1,2,3,4,5,6,7,9 \quad (2)$$

Results are reported in table 6 for associate professorships and in table 7 for full professorship.[9] *They indicate that there is no evidence of a general decline in the quality of the selections after the reform leading to local competitions, however* a significant heterogeneity is evident across research areas, suggesting differences in co-optation traditions*:* when significant the intercept and the slope of these regression lines are lower in the second sub period (this being more evident in the case of full professorships).

Using this proxy for the quality of the selection, we do not find any change at the mean associated to the decentralisation reform (columns (1) in tables 6 and 7). Conversely an overall negative, though poorly significant, effect of both reform and the slope onto bibliometric disciplines is associated with full professorship promotions only, no effects are associated with associates promotions (columns (2) in tables 6 and 7). Reform effects are detected in Chemistry, for full professor selection procedures and in Biology for associate ones. Effects on slopes are detected in Chemistry, Agriculture and Veterinary and Industrial engineering and ICT for full professor selections and in Physics, Chemistry, Biology and Agriculture and Veterinary areas for associates ones. Results over the other measures of scientific productivity (citations and impact factors) are even less significant, and therefore are not reported here.

[commento effetto su mover e interaction mover per trend è da discutere]

[8] By so doing we are implicitly assuming that whenever there is an opening for associate professorship, all assistant professors are potentially applying to the competition (and similarly with associate professors in case of competitions for full professorships). By anecdotal evidence, this assumption is realistic in the case of national competitions (when selection took place in a very irregular timing), while it is an upper-bound approximation for the second sub period (when applicants were entitled to apply to a maximum of five competitions per year. However, since each competition gave origin to three/two promotions, we think that this approximation may still be acceptable.

[9] Equation (2) cannot be estimated for competition to assistant professorship, since it is impossible to collect information about potential applicants. Notice that observations are now defined with reference to the number of observed promotions (see table 4).

Table 6 - Quality of the selection of associate professors, by research area – productivity measured by number of ISI products

	1	2	3	4	5	6	7	8	9	10
	all areas	area=1-7+9	area=1	area=2	area=3	area=4	area=5	area=6	area=7	area=9
trend	0.021	-0.004	-0.107	0.109***	0.083*	-0.071	0.130**	0.053	-0.219**	0.053
	[0.056]	[0.027]	[0.095]	[0.024]	[0.038]	[0.146]	[0.051]	[0.047]	[0.092]	[0.051]
reform	-0.340	-0.200	-0.472	-0.133	-0.315	-0.089	-0.796*	0.014	0.043	-0.449
	[0.310]	[0.135]	[0.631]	[0.174]	[0.291]	[0.496]	[0.404]	[0.303]	[0.355]	[0.291]
reform×trend	-0.042	-0.009	0.099	-0.150***	-0.084*	0.048	-0.121**	-0.076	0.214*	-0.073
	[0.059]	[0.029]	[0.098]	[0.026]	[0.039]	[0.177]	[0.055]	[0.063]	[0.105]	[0.055]
mover	0.717**	0.125	-0.164	0.104	0.272	0.258	0.532	0.753	-0.437	-0.192
	[0.347]	[0.134]	[0.273]	[0.197]	[0.213]	[0.762]	[0.391]	[0.464]	[0.625]	[0.169]
mover×reform	-0.708*	-0.115	-0.027	-0.503	-0.246	-1.121	-0.838*	-0.150	0.726	-0.115
	[0.404]	[0.174]	[0.301]	[0.444]	[0.400]	[0.862]	[0.455]	[0.555]	[0.733]	[0.246]
Observations	18864	10023	1028	681	999	398	1373	2374	1167	2003
R^2	0.006	0.031	0.071	0.041	0.066	0.053	0.075	0.078	0.037	0.034

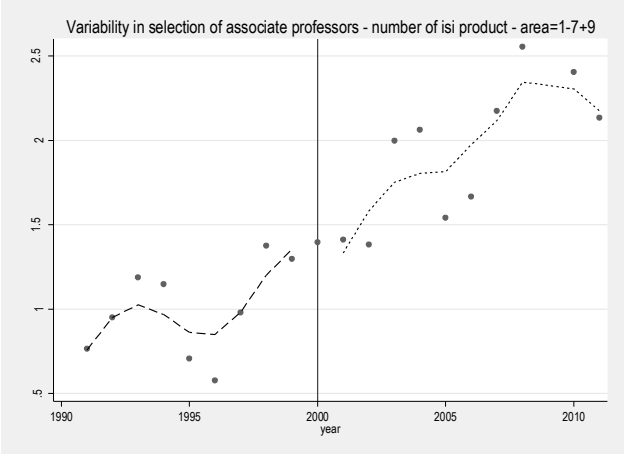
*significant at 10%; ** significant at 5%; *** significant at 1%
standard errors clustered by research field (ssd) in brackets - region controls included

Table 7 - Quality of the selection of full professors, by research area – productivity measured by number of ISI products

	1	2	3	4	5	6	7	8	9	10
	all areas	area=1-7+9	area=1	area=2	area=3	area=4	area=5	area=6	area=7	area=9
trend	0.034	0.070	-0.074	0.071	0.421***	-0.406	0.033	0.084	0.163**	-0.125**
	[0.058]	[0.048]	[0.102]	[0.144]	[0.130]	[0.378]	[0.092]	[0.103]	[0.079]	[0.058]
reform	-0.193	-0.640*	0.080	-1.443	-3.043***	0.553	-0.203	-0.720	-0.248	-0.109
	[0.378]	[0.370]	[0.660]	[1.090]	[0.808]	[1.459]	[0.676]	[0.877]	[0.323]	[0.175]
reform×trend	-0.030	-0.090*	0.042	-0.048	-0.427**	0.373	-0.084	-0.102	-0.227*	0.104*
	[0.064]	[0.048]	[0.108]	[0.149]	[0.135]	[0.377]	[0.090]	[0.097]	[0.111]	[0.058]
mover	0.424	0.339	0.820	-0.997**	0.086	0.072	0.487	0.043	1.342	-0.945**
	[0.257]	[0.261]	[0.649]	[0.393]	[0.185]	[1.557]	[0.400]	[0.709]	[0.843]	[0.380]
mover×reform	-0.166	-0.108	-0.832*	1.074**	0.137	1.213	-0.090	0.447	-1.625*	1.069**
	[0.330]	[0.277]	[0.384]	[0.430]	[0.337]	[1.758]	[0.394]	[0.756]	[0.947]	[0.417]
Observations	13708	7025	589	486	685	253	965	2006	786	1255
R^2	0.004	0.033	0.070	0.127	0.138	0.160	0.077	0.053	0.051	0.045

*significant at 10%; ** significant at 5%; *** significant at 1%
standard errors clustered by research field (ssd) in brackets - region controls included

Even if the first moment may have not changed, it is possible that the second (or higher moments) have changed. In figures 7 to 9 we plot the coefficients of variation computed for promoted professors over the three dimensions of scientific productivity we have available (number of ISI product, citations and impact factor). In this case we show that there is evidence of increased variability in the productivity of promoted associate professors, while the opposite trend reveals for full professorships. By combining previous results, despite our measures of scientific productivity being clearly trended (due to the increased coverage of the underlying database and to the rising internationalisation of Italian academics), *we can conclude that the decentralisation reform seems not having provoked a decline in the quality of promoted professors*. Despite the claim of increased nepotism (Durante et al. 2011), decentralisation has allowed for greater flexibility in recruitment, at least in the case of young new entries (as clearly seen by the increased variability in productivity across promoted associate professors).



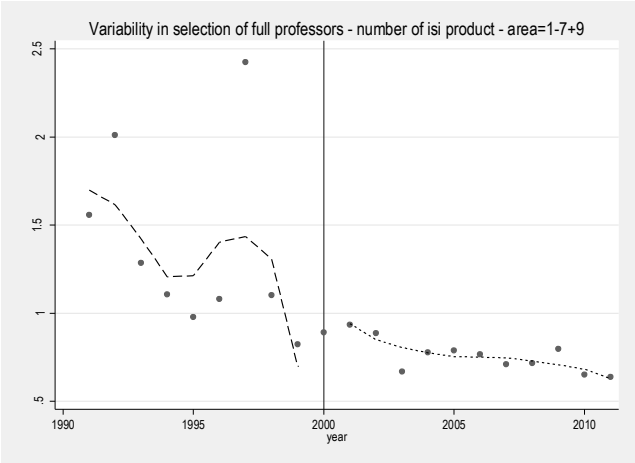
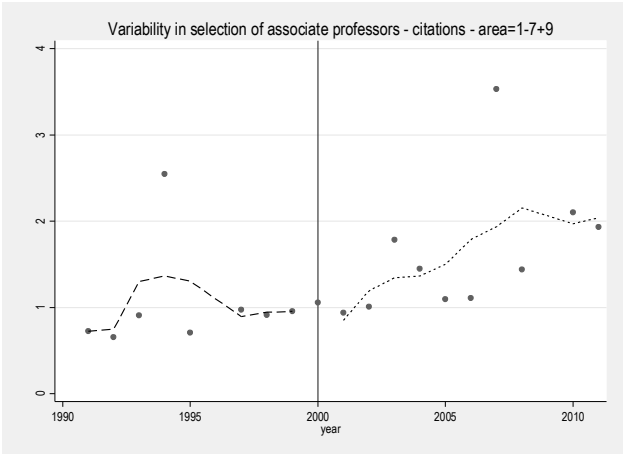


Figure 7 - Variability in selection of promoted professors – ISI product



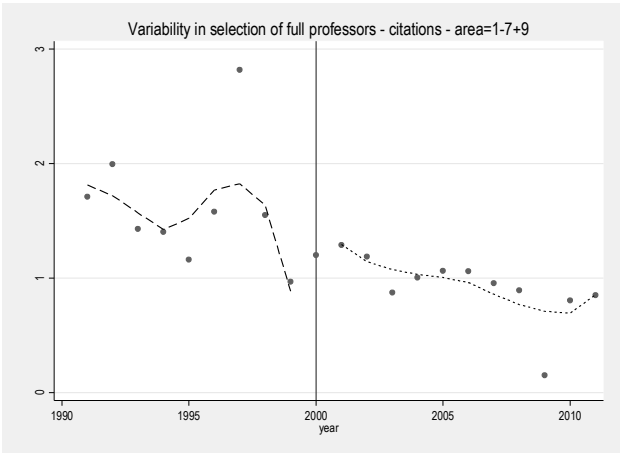
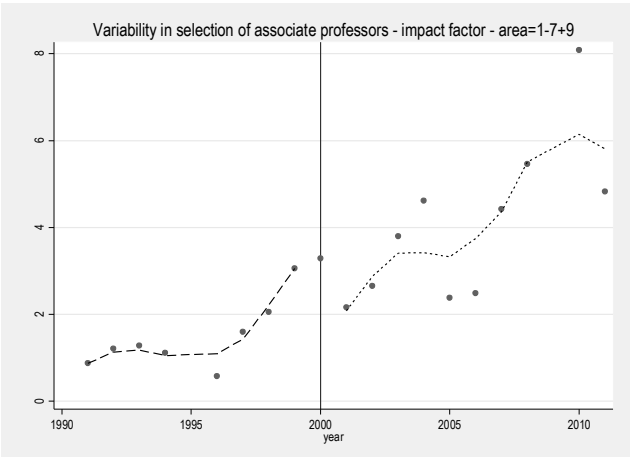


Figure 8 - Variability in selection of promoted professors - citations



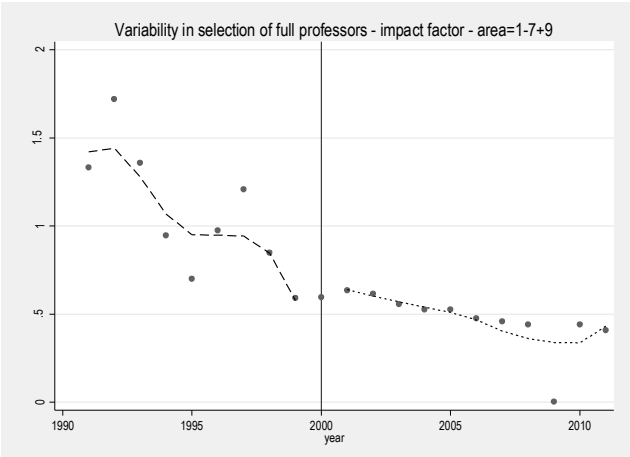


Figure 9 - Variability in selection of promoted professors – impact factor

6. The selection procedure

We now move deeper in the analysis of the selection process. As starting point, we proceed to counting the fraction of "misallocated" candidates, i.e. in a competition with k openings, we compute the fraction of non-winner with a rank (in terms of within-field scientific productivity measured by ISI product) greater than k. Leaving aside the problem of ties, this is equivalent to the number of promoted professors with a rank lower than k. In other words we aim to identify the number of "wrong" promotions, had the promotions been awarded according to the criterion of ISI-WoS records only. This measure is computed at the level of each 372 research subfield, since it is at that level that ranking of candidates can be appropriately defined. The problem comes in with the local competitions, where we do not observe the actual participants to each local competition. Thus we have to interpret the reform as a regime change, where the number of vacancies is the sum of the vacancies available that year.

There is another problem in computing such an index, which are ties. Not breaking the ties lead to indexes exceeding one, because there are long queues of zero productivity researchers. For this reason, we have chosen a procedure that arbitrarily breaks the ties. In the following figures 10 and 11 we show the evolution of this measure of quality of the selections. We observe is a clear overall increase in the fraction of "wrong" winners, which is also detectable for each of the selected bibliometric disciplines: on average this fraction increased over the whole sample from 45% to 54% for associate professorships and from 46% to 52% for full professorships.

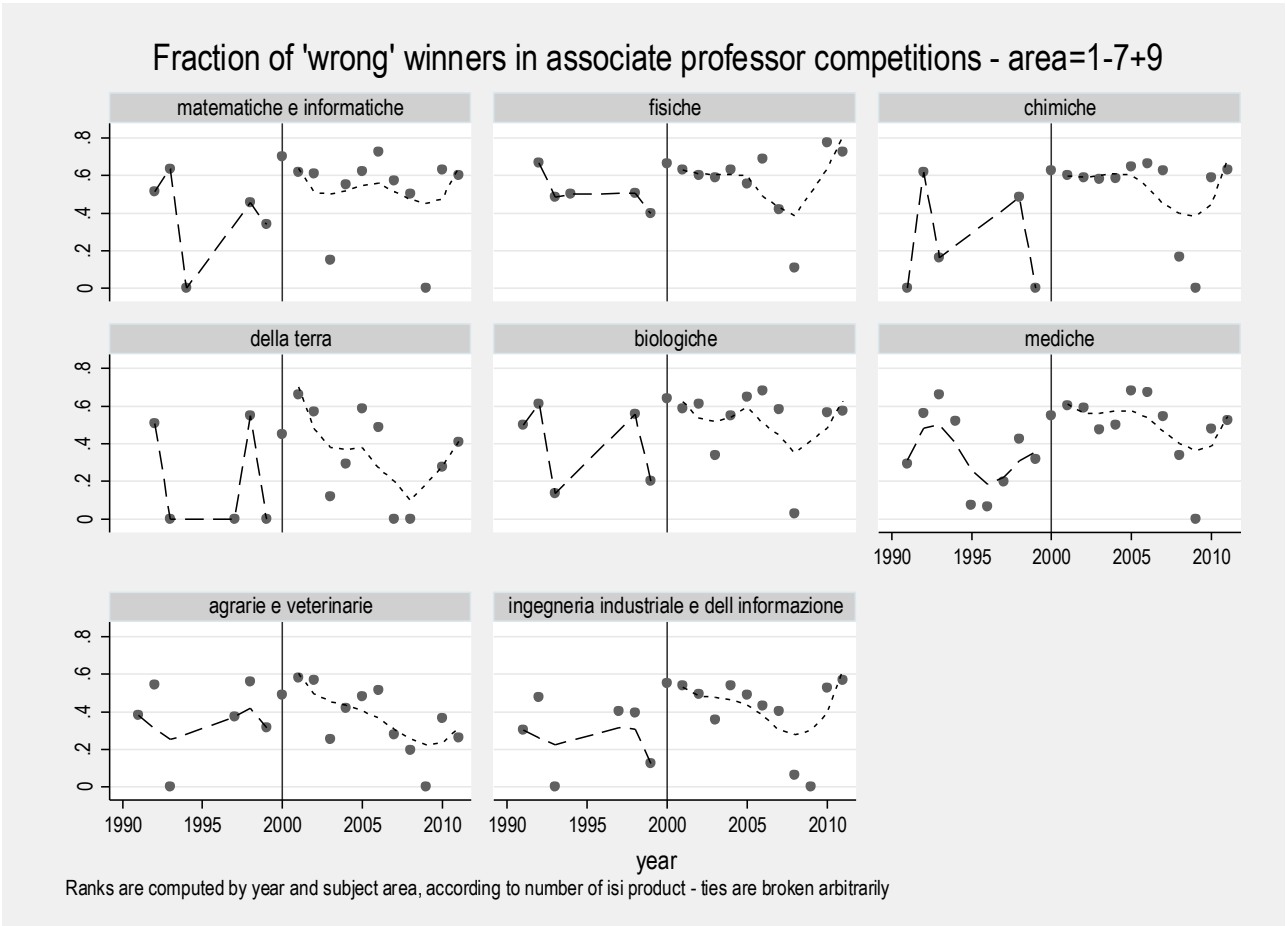


Figure 10 - Quality of selection by fraction of wrongly ranked associate professors winners - selected research areas

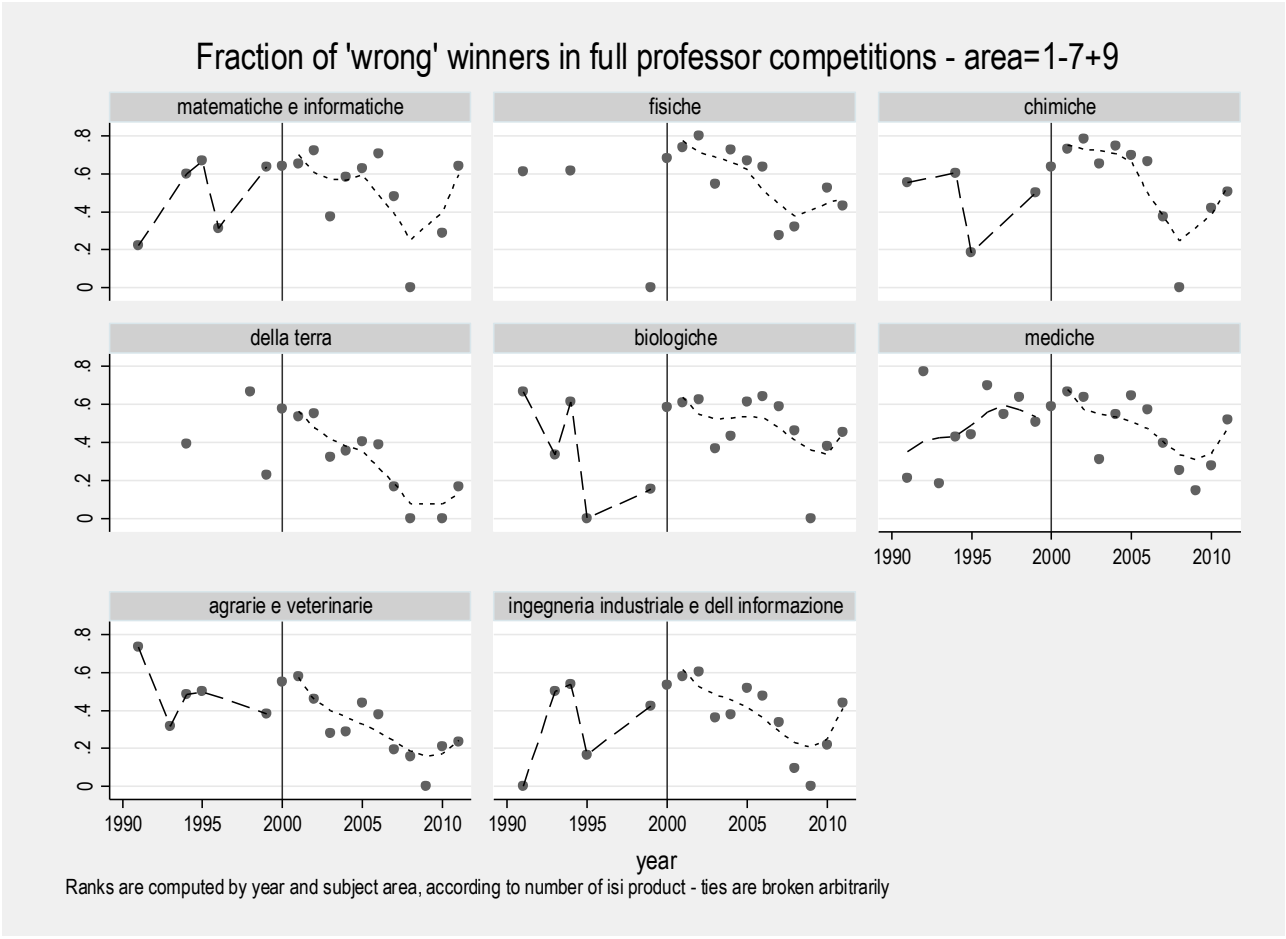


Figure 11 - Quality of selection by fraction of wrongly ranked full professor winners - selected research areas

If we change our unit of analysis by collapsing the data by year and research field, we can compare these means before and after the reform (still using a field fixed effect control). In such a case we observe an increase in the index, which is more pronounced for associate than for full professors (see table 8). *Thus the selection of professors under the local system seems to rely less on scientific productivity as measured by the number of ISI-WoS records*. This is consistent with the increased variability in the quality of appointed professors, signalled by figures 7 to 9.[10]

Table 8 -Quality of the selection of professors, by research area
- productivity measured by number of ISI products

	1	2	3	4
	associate professors all sectors	full professors all sectors	associate professors 1-7+9 area sectors	full professors 1-7+9 area sectors
reform	0.082	0.046	0.147	0.024
	[0.010]***	[0.013]***	[0.036]***	[0.087]
ties	0.248	0.253	0.173	0.191
	[0.011]***	[0.011]***	[0.021]***	[0.019]***
Observations	3499	2939	1411	1245
R^2	0.4	0.37	0.33	0.31

*significant at 10%; ** significant at 5%; - *** significant at 1% - std.errors clustered by scientific sector in brackets
- constant, year and subfield fixed effects included

[10] Notice that our measure of misallocation depends on how we solve the problem of ties. Since in the present version ties are randomly broker, we control for it by means of an appropriately defined dummy variable.

Despite the lack of mean effects in the productivity indicators (see previous section), the increased variability in the quality of promoted professors and the increased share of "wrongly" selected point in the direction of *a change in the selection criteria, as a reflection of the change in the selecting committees*. In order to investigate such a change, we estimate linear probability models for being promoted using all information available on the scientific productivity of the candidates (see table 9). As in the previous case, we take all the professors who are appointed at the inferior level as potential competitors for promotions. From this table we observe that scientific productivity (in terms of both quantity – ISI product – and quality – impact factor) and notoriousness (being cited) affect the probability of being promoted, more in the case of competition for associate professorships than in the case of competitions for full ones.

The local competition seems to have shifted attention of the selecting committees from productivity to visibility. Then a linear probability model is estimated to study the effect of decentralisation on the determinants of the probability of being selected as associate or full professors, conditional on being employed at previous level of assignment. Results (see table 9) show evidences of positive effects of quantity and impact measures and negative effects of notoriousness for locally recruited professors on the probability of being promoted both to associates and to full professors with standard careers. Unclear results are associated with unusual careers, and therefore are not reported.[11] The temporal evolution of these effects are shown in figures 13a and 13b.

Table 9 - Probability of being selected as associates/full professor, conditional on being assistant/associate professors, research areas 1-7+9 – linear probability model

	from assistant to associate professors				from associate to full professorship			
	1	2	3	4	5	6	7	8
age	0.00056	0.00075	0.00081	0.00057	-0.00012	-0.00047	-0.0005	-0.0001
	[0.00010]***	[0.00011]***	[0.00011]***	[0.00010]***	[0.00009]	[0.00008]***	[0.00008]***	[0.00009]
female	-0.01178	-0.01442	-0.01473	-0.01184	-0.01146	-0.01292	-0.01306	-0.01142
	[0.00096]***	[0.00085]***	[0.00087]***	[0.00094]***	[0.00103]***	[0.00090]***	[0.00093]***	[0.00102]***
number of ISI records	0.00304			0.00304	0.00139			0.00139
	[0.00027]***			[0.00027]***	[0.00010]***			[0.00010]***
citations		0.00049		0.00021		0.00042		0.00018
		[0.00006]***		[0.00004]***		[0.00005]***		[0.00004]***
impact factor			0.00388	-0.00065			0.00243	-0.00088
			[0.00037]***	[0.00026]**			[0.00029]***	[0.00029]***
reform	0.08452	0.06428	0.06873	0.08253	0.06304	0.06006	0.06227	0.06129
	[0.00670]***	[0.00644]***	[0.00642]***	[0.00659]***	[0.00972]***	[0.00979]***	[0.00986]***	[0.00965]***
trend	-0.00483	-0.00304	-0.00313	-0.00505	-0.00297	-0.00151	-0.00146	-0.00308
	[0.00059]***	[0.00058]***	[0.00057]***	[0.00061]***	[0.00058]***	[0.00057]***	[0.00058]**	[0.00059]***
reform×trend	-0.00256	-0.00328	-0.00385	-0.00233	-0.00314	-0.00478	-0.00517	-0.00292
	[0.00094]***	[0.00090]***	[0.00089]***	[0.00093]**	[0.00118]***	[0.00115]***	[0.00116]***	[0.00118]**
reform×ISI products	-0.00017			-0.00018	-0.00009			-0.00009
	[0.00002]***			[0.00002]***	[0.00001]***			[0.00001]***
reform×citations		0.00004		0.00002		0.00003		0.00002
		[0.00001]***		[0.00001]***		[0.00001]***		[0.00001]***
reform×impact factor			0.00006	0.00011			0.00008	-0.00001
			[0.00003]**	[0.00003]***			[0.00002]***	[0.00002]
Observations	257639	257639	257639	257639	218930	218930	218930	218930
R^2	0.07	0.05	0.05	0.07	0.05	0.04	0.04	0.05

* significant at 10%; ** significant at 5%; *** significant at 1% -
standard errors clustered at ssd in brackets - area and region controls included

[11] We restrict to standard career paths, such as assistant promoted to associate professor and associate promoted to full professor, leaving aside unusual careers such as associate/full professors directly recruited from outside the academia or assistant directly promoted to full professor.

Finally we may ask whether the increased variability in the scientific productivity of promoted professors may be the results of increased polarisation in the criteria followed by selecting committees (more correctly: by the departments who hired these professors). We have proxied this effect by computing a rank indicator of scientific productivity by year (21), university (94) and research field (372 *settori scientifico-disciplinari*) and we have interacted it with the corresponding individual measure (of relative quality) of promoted professor. In the following figure 12 we show the relationship between the scientific rank of the departments and the individual measure of productivity of the promoted professors under the two regimes. We observe a polarization effect with high quality department (in term of their rank based on the quantity of published papers on ISI) recruiting better candidates under the local system in the research fields belonging to Mathematics and Computer Science (area 1), Physics (area 2) and Chemistry (area 3). Earth Science (area 4), Biology (area 5) and Medicine (area 6) show no significant differences in their recruiting behaviours while Agricolture and Veterinary (area 7) and Industrial Engineering and ICT (area 9) hire worse under the local system. Results over the other ranks of scientific productivity (citations and impact factors) are very similar and not reported here.

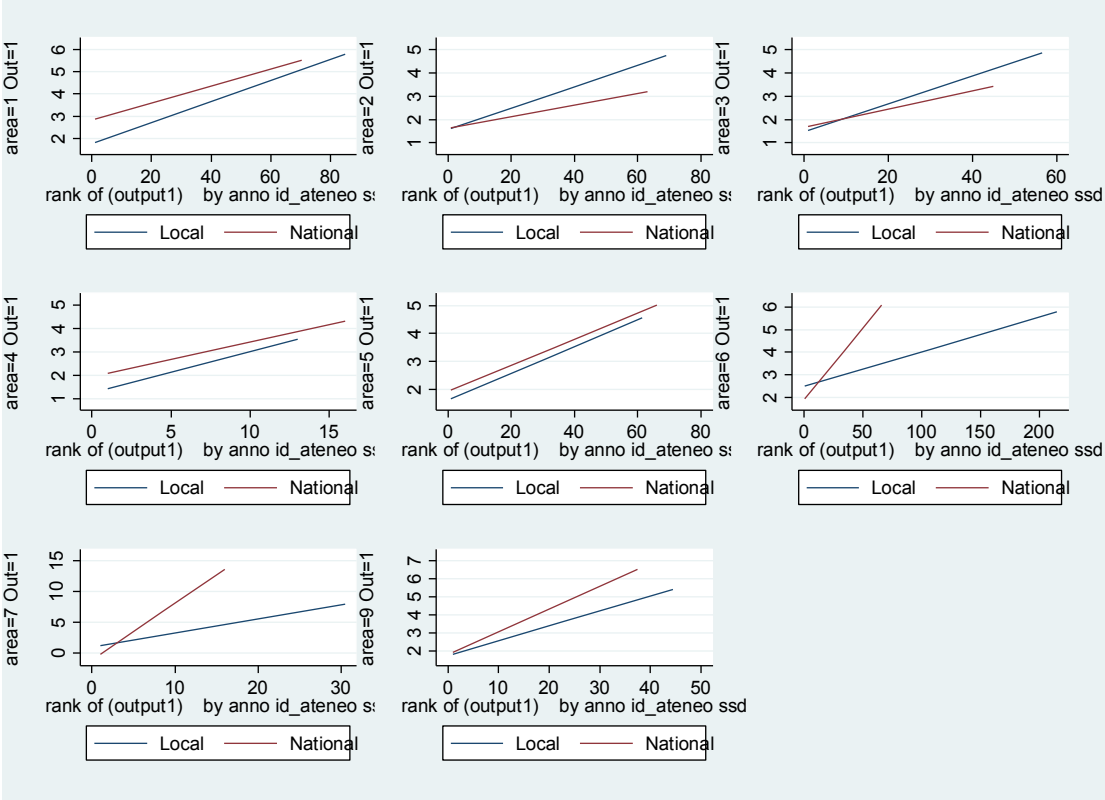


Figure 12 – Scientific rank (based on the number of ISI publications) of hiring departments by relative quality of the hired professors - bibliometric research areas only

Each indicator of scientific productivity/visibility/impact is then interacted with the rank of the same indicator at university/research field. This is just a proxy of the quality of departments, since there may be more than one department in each university gathering professors of the same research field. We consider these people as members of the same "ideal" department, since they could have been at least consulted during the hiring procedure of new professors. We have also added a triple interaction with the reform in order to see whether some change is detectable after the reform. In other words, we want to test a *homophile* hypothesis, namely that more productive professors tend to hire more productive candidates.

There is a subtle distinction between promotions and hiring, which become relevant here. Since our dataset on professors is built on administrative archives, we do observe change of assignment

(*inquadramento*) and we take this as evidence of being qualified (*idoneità*), since the latter is a necessary condition for the former. However we do not have information about candidates who were declared qualified without being ever hired as professor. This was a rather rare event under the national competition system, but became more frequent under the local competition one. In national competitions the number of vacancies was equivalent to the number of qualified candidates, and therefore residual universities and residual candidates were forcefully matched by the Ministry of University. On the contrary, local competitions allowed greater degrees of freedom to university departments, since they were allowed to hire candidates who obtained their qualifications in competitions managed by other universities (conditional on the local availability of funds). Thus we would expect that decentralisation of competitions could have induced better matches between academic departments and qualified candidates.

However these indicators behave in a strange way. Taken at face value (but notice the very small magnitude of the probability contribution) a candidate with a higher scientific productivity (number of ISI-WoS products) is less likely to be hired by a department/university with a higher (average) productivity (again measured by the number of ISI-WoS products), but this effect is attenuated after the reform (implying that the reform favoured polarisation of behaviours). The same situation would occur when considering the other two indicators when the effects are statistically significant. Movers are overall more likely to be hired and the effect is greater for associates with respect to full professors. However when interacted with reform the effect is negative for associates, implying that movers in the second regime are less likely to be hired. Full professors show a positive, but poorly significant effect, of this interaction when significant.

[ultime due triple e quadruple interazioni da discutere…]

Table 10 - probability of being selected as associate or full professors, conditional on being at previous stage

	1	2	3	4	5	6
	from assistant to associate	from associate to full professor	from assistant to associate	from associate to full professor	from assistant to associate	from associate to full professor
	output = # ISI product		output = citations		output = avg.impact factor	
age	0.00058***	0.00015*	0.00081***	-0.00022***	0.00086***	-0.00024***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
female	-0.00958***	-0.01010***	-0.01259***	-0.01186***	-0.01276***	-0.01203***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
output	0.00356***	0.00172***	0.00053***	0.00050***	0.00458***	0.00309***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
reform	0.07160***	0.05442***	0.06099***	0.05954***	0.06429***	0.06254***
	[0.007]	[0.010]	[0.006]	[0.010]	[0.006]	[0.010]
time	-0.00426***	-0.00277***	-0.00326***	-0.00179***	-0.00312***	-0.00177***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
reform x time	-0.00146	-0.00192	-0.00258***	-0.00434***	-0.00328***	-0.00471***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
mover	0.49068***	0.14578***	0.50000***	0.14772***	0.49961***	0.14792***
	[0.022]	[0.007]	[0.022]	[0.008]	[0.022]	[0.008]
mover x reform	-0.08237**	0.01673	-0.08076**	0.03760*	-0.05945	0.04230*
	[0.041]	[0.021]	[0.037]	[0.020]	[0.039]	[0.023]
reform x output	-0.00021***	-0.00010***	0.00004***	0.00003***	0.00001	0.00009**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
mean output	-0.00042***	-0.00048***	0.00015*	-0.00012*	-0.00082	-0.00097*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
mean output x individual output	-0.00007***	-0.00003***	-0.00001***	-0.00001***	-0.00006***	-0.00002
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
reform x mean output x ind.output	0.00006***	0.00002***	-0.00000	0.00000	0.00003**	-0.00002
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
reform x mean output x mover	0.00337***	0.00210***	0.00393***	0.00104	0.01005	0.00480
	[0.001]	[0.001]	[0.001]	[0.001]	[0.007]	[0.007]
reform x mean output x mover x ind.output	0.00003*	-0.00002	-0.00008	0.00001	-0.00023	0.00000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	257639	218930	257639	218930	257639	218930
Pseudo R^2	0.123	0.066	0.107	0.056	0.107	0.055

linear probability model - ** significant at 5%; *** significant at 1% -
standard errors clustered at ssd in brackets – area, region and year controls included

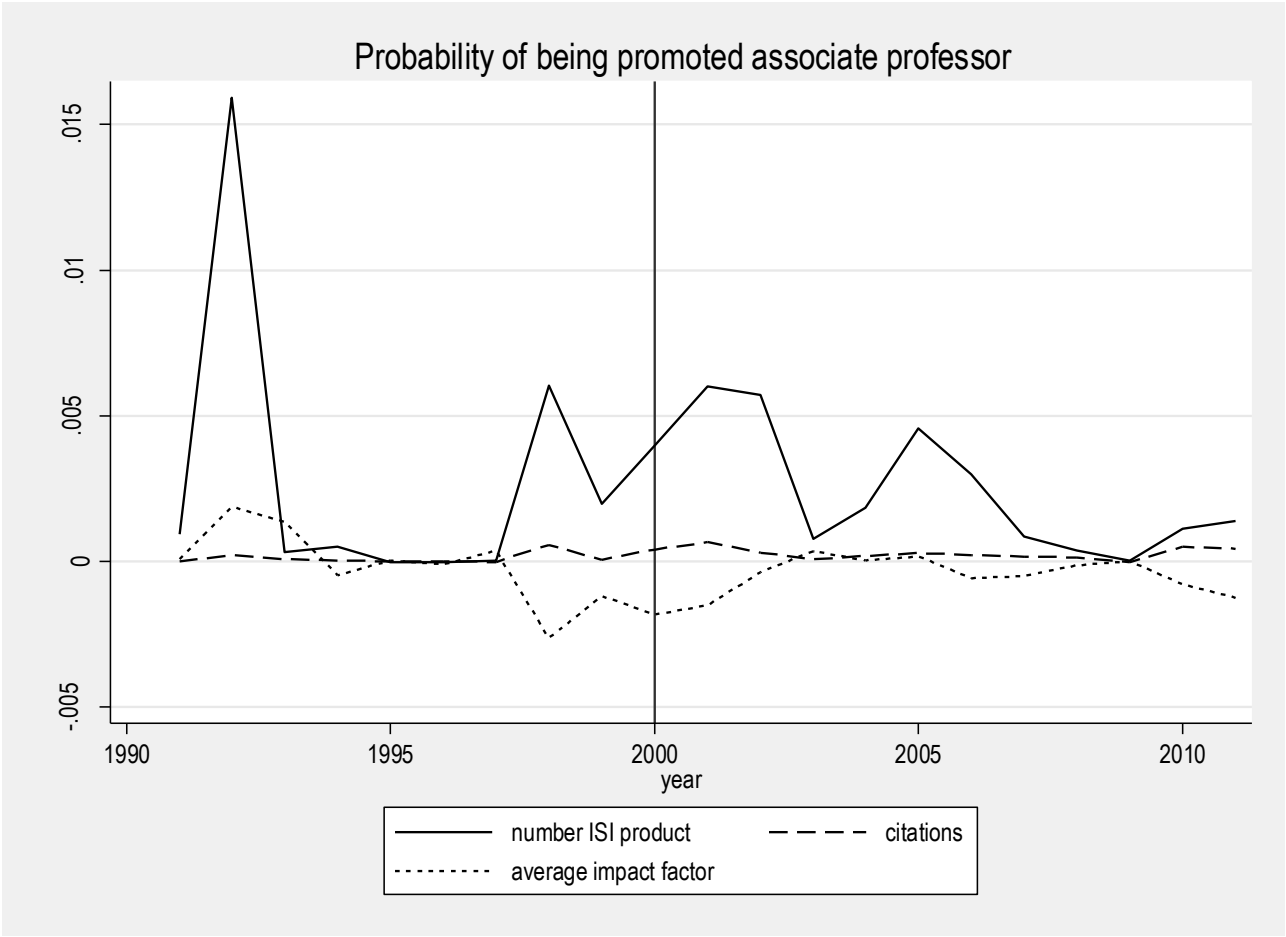


Figure 13a - Probability of being promoted from assistant to associate professor (marginal contribution in probability)

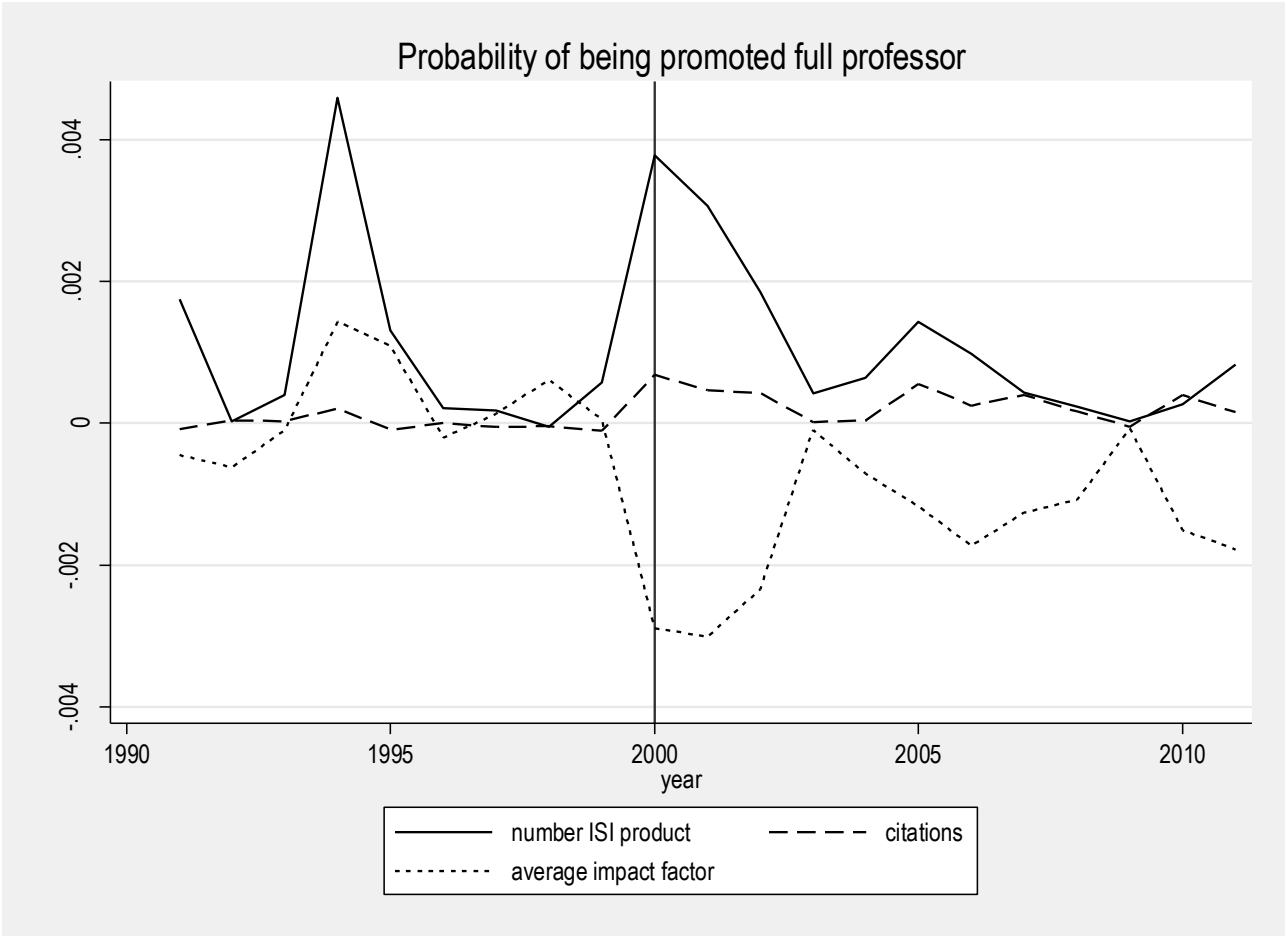


Figure 13b - Probability of being promoted from associate to full professorships (marginal contribution in probability)

7. Conclusions

The aim of this paper is to measure the impact of decentralising recruitment at university level onto the quality of selected/promoted academic professors in Italy. Using a standard treatment approach we identify some evidence of a reduction in the international research quality of researchers hired with local competitions after the year 2000, but this effect is limited to bibliometric research areas. An overall clear negative effect of the whole system is not statistically significant. A large degree of heterogeneity is also evident across research areas. Moreover we show a clear increase in the variability of the scientific productivity of locally promoted professors with respect to national ones.

We also document an increase in the fraction of misallocated candidates (defined as the fraction of non-winners with higher rank than the corresponding winners) at the level of each 372 research field after the decentralisation reform. The fraction of misallocated on average increased over the whole sample from 45% to 54% for associate professorships and from 46% to 52% for full professorships.

We explore the issue of the promotions criteria adopted by the selecting committees under the two regimes (national vs local), and we find a reduced relevance of quantity of publication measures for local selection committees (with respect to nationals) as well as an increase in importance in notoriousness and impact after decentralization.

Finally we wonder whether the increased variability in scientific productivity could be the result of an increased polarisation in the hiring criteria followed by academic department. We find evidence that candidates with higher scientific productivity are unusually less likely to be hired by departments with an average higher productivity. But this particular effect is attenuated after the reform. So that we can argue that the reform has favoured polarisation of hiring behaviours.

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