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Career progress in centralized academic systems: Social capital and institutions in France and Italy

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ABSTRACT

We analyze the role of social capital in academic careers. We distinguish between ties with reputed scientists and laboratories (scientific and technical human capital) and ties with influential actors with respect to recruitment/promotion decisions (political capital). We use institution-wise bibliometric indicators to measure separately the two types of capital for a large sample of French and Italian academic physicists between 2000 and 2003/2005. Controlling for scientific productivity, seniority and gender issues, career progress is explained by: the scientist's affiliation to important public research organizations (scientific and technical human capital – France); his/her social ties with senior members of the discipline, who exercise control over careers (political capital – Italy), and the commitment to work with senior colleagues in his/her own university (political capital – Italy). Significant differences exist between the two countries also with respect to the importance of productivity, seniority, and gender.

1. Introduction

In the past 15 years or so, the number of empirical contributions to the economics of science has grown considerably (Stephan, 2012). This literature has focused especially on the rate and direction of university research and on how the latter may be affected by changes in funding patterns (Geuna, 1999), and the spread of commercialization practices (surveys by Geuna and Nesta, 2006; Siegel et al., 2007). Several essays have also dealt with the issue of scientific productivity and its determinants at the individual level (Stephan and Levin, 1992; Hall et al., 2007; and in relation to technology transfer: Azoulay et al., 2007; Breschi et al., 2007). Very few, however, have examined explicitly the issue of academic careers, the main exceptions being limited to the US case (as with Ehrenberg, 2003).[1]

The present paper contributes to filling this gap, with special reference to highly regulated academic labor markets typical of Continental Europe. In particular, we examine the cases of university careers in France and Italy.

In order to do so, we update the conceptual framework of the Mertonian sociology of science (as received from the new economics of science), build upon early empirical work on academic careers in that tradition (Long et al., 1993; Long and Fox, 1995), and examine useful notions of social capital, specifically tailored to the institutional features of academia in the two countries.

In both France and Italy, academic careers are heavily controlled by disciplines, the latter to be intended as state-sanctioned guilds of professors, over which universities exercise little control. In addition, both countries host large and powerful public research organizations (PROs; such as the CNRS, *Centre Nationale de la Recherche Scientifique*, in France; and the CNR, *Centro Nazionale delle Ricerche*, in Italy), which act as important channels of funding and legitimization of academic research. Finally, both countries exhibit various degrees of localism in their promotion patterns.

By taking into account these national specificities, we propose as set of notions of social capital that are both of immediate relevance for the national cases at hand and of general interest, as they lend themselves to be measured with archival data. We find them

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[1] Outside the economics of science literature we find isolated contributions from economists who are interested in the analysis of recruitment examinations in their own discipline (Ginther and Kahn, 2004; Combes et al., 2008).

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to have non-negligible explanatory power for promotion events. In particular, we find that ties to large PROs matter in France, but not in Italy, where connections to senior members' of one's own discipline are of greater importance. We also find significant differences between the two countries with respect to the importance of productivity, seniority, gender, and the importance of localism.

In Section 2, we provide a brief summary of the relevant literature, and discuss the notion of social capital in scientific careers. In Section 3, we discuss the specificities of the Italian and French academic systems, along with the consequences they bear for our analysis. In Section 4 we put forward our analytical statements, and describe our data and methodology. In Section 5 we report and discuss the results of our empirical analysis. Section 6 concludes.

2. Literature review

Academic careers can be analyzed according to four dimensions: participation, position, productivity, and recognition (Long and Fox, 1995). In this paper, we focus mainly on position, in particular on career progress within or across organizations.[2]

In this respect, the economics of science has taken on board, without much discussion, the classical sociological analysis proposed by Merton (1957), as reformulated by Dasgupta and David (1994). According to such perspective, scientists progress in their careers to the extent that they gain some reputation for their contribution to knowledge advancement. Such reputation must be obtained from academic peers, who rely for their judgement on their colleagues' publication record.

Scientists' individual characteristics, such as seniority and gender, may interfere with this process. The same applies to the prestige of the institution at which the scientist graduates (Long et al., 1993; Long and Fox, 1995).

Social capital may also play a role. An individual's set of contacts in the scientific community may serve as an indicator of the knowledge resources he/she has access to, which in turn indicates their potential productivity. Alternatively, such contacts may be mobilized in order to influence the committees in charge of examining a job application or a request of promotion. In this respect, social capital can be ideally split into *scientific and technical human capital* (S&T HU, as defined in Bozeman et al., 2001; see below) and *political capital*, the latter to be intended as the number and strength of useful contacts a scientist may have among his/her peers, senior colleagues or other agents from whose decision his/her career depends.

2.1. Evidence on productivity and individual characteristics

Several studies over a long period of time have tried to assess the importance of scientific productivity for academic careers. In particular, many efforts have been made to distinguish the effect of quantity (number of publications) and quality (impact of publications, usually measured with citations). While the impact of quantity is beyond doubt (see, for example, Clemente, 1973), the role of quality is more controversial. Early work by Hargens and Farr (1973) found that the number of citations received is positively associated with promotion, but their results were not confirmed by later works (such as Long et al., 1993).

For what concerns the issue of gender, women in science appear both to enjoy fewer promotion opportunities and also to suffer from a productivity gap, other things being equal (Allison and Stewart, 1997; Long, 1978; Levin and Stephan, 1991; Stephan and Levin, 1992; Xie and Shauman, 1998; Zainab, 1999; Prpic, 2002; Hall et al., 2007).[3] Long et al. (1993) find that even after controlling for productivity, female scientists have a lower promotion probability. Similar results have been found by Cole (1979), Everett (1994) and Modena et al. (1990).

Similar issues arise when examining the role of seniority. In many jobs, career progress is a matter of time: seniority is rewarded (either formally or informally) with promotion. Academic jobs are no exception (Long et al., 1993; Modena et al., 1990). The time spent by a scientist in a given academic position is always found to be one of the most important factors determining promotion, either directly (more senior researchers stand higher chances of being promoted, ceteris paribus) or indirectly, via scientific production (more senior scientists accumulate a longer list of publications, which may be of help in getting promoted).

2.2. Social capital: scientific and technical vs. political

It is reasonable to assume that universities, when deciding to fill a vacancy or offer a promotion, give positive consideration to the size and reach of candidates' personal network (for example, PhD supervisors or co-authors) to the extent that the latter may add to the university's visibility and access to resources (Gonzalez-Brambila et al., 2006). As individual performances are often hard to evaluate only on the basis of past scientific production and citations (especially when junior scientists are considered, whose publication list is necessarily short), prospective recruiters may look for other signals of quality, and past collaborations are one of these.[4] They constitute a form of social capital from which the individual can draw knowledge resources either to increase or to match his/her own.

In order to capture this aspect of social capital, which is highly complementary to the individual human capital, Bozeman et al. (2001, pp. 5–6) put forward the notion of scientific and technical human capital (S&T HU) "as the sum of scientific, technical and social knowledge, skills and the resources embodied in a particular individual", [...] which "encompasses not only the individual human capital endowments but also researchers' tacit knowledge, craft knowledge, know-how [and] the social capital that scientists continually draw upon in creating knowledge—for knowledge creation is neither a solitary nor singular event".

Expanding further this notion, all social ties an individual may have established in prestigious universities and research labs, either by moving across different institutions or by collaborating with several scientists, can be considered as a relevant form of social capital.

The relationship between career advancement and the prestige of the universities has been widely investigated. On the one hand, having graduated or worked in a prestigious institution gives access both to information and to knowledge embedded in other productive scientists, which makes promotion easier. On the other hand, more prestigious university departments apply stringent selection criteria, which signal their graduates as individuals with great potential (Long et al., 1993).

Evidence for the US suggests that departmental reputation affects productivity, but that the prestige of the PhD-granting institution is one of the most useful predictors of career advancement, even after controlling for productivity (Hargens and Hagstrom,

[2] According to Long and Fox (1995), *participation* merely regards the employment in science, *productivity* refers to contributions to scientific knowledge and *recognition* concerns the reputation within the scientific community.

[3] Several reasons have been put forward to explain why women appear to be less productive than their male counterparts: limited access to relevant social networks (exclusion from "old boys" social circles; Cole and Zuckerman, 1984); a tendency to deal with applied, rather than more prestigious pure research; lower graduation rate from prestigious universities; more severe family-career trade-offs.

[4] For some evidence in this direction, albeit not within the academic realm, see Seibert et al. (2001).

1967; Allison and Long, 1990). Moreover Long et al. (1979) find evidence that entry into an academic career does not depend on scientific productivity, if one controls for the effects of doctoral prestige.

In the case of Continental Europe, results are more mixed. Sabatier et al. (2006) and Heining et al. (2007) find no or limited evidence of an impact of doctoral prestige, respectively for French life science scientists, and for German economists; while Gaughan and Robin (2004) find that bachelor graduation from top universities foster academic career as much in France as in the US.

Job mobility contributes to scientist's S&T-HU capital to the extent that it increases the number of collaborations and strengthens existing relationships. For this reason it is possible to expect a positive relationship between mobility and career success. However Sabatier et al. (2006), using a sample of 583 French scientists in the field of life science in one of the national research centre, and Heining et al. (2007), using a sample of 243 German professors in the field of economics, do not find any clear evidence. In particular, Heining et al. (2007; p. 19) explain this result by suggesting that "moving destroys (or at least weakens) the ties in social networks which could turn out important for the tenure decision". Notice however that the importance of social capital for tenure decision may have less to do with the knowledge value of such capital, than with the political leverage it may provide when it comes to competing for a specific appointment or promotion. It is to this second function of social capital that we now turn.

For the purposes of career advancement, such capital consists in all social relations of the individual's that may bear a direct influence on decisions pertaining the his/her career. Most of these ties may be the same that also provide for S&T-HU capital, as when a supervisor or senior co-author is both a source of knowledge and a member of a recruitment committee. But the two concepts of capital are conceptually distinct, and the same applies to the channels through which they operate.

A well-recognised instance of political capital is that provided by mentors. The 'mentor' is typically a senior member of an organization who commits to facilitating the careers of his/her students or junior colleagues (Kirchmeyer, 2005). Mentors may influence the career success of their students and colleagues either indirectly, by improving the latter's performance (in which case they provide S&T-HU capital), but also directly, by introducing them to their own social network and providing contextual signals of reputation and ability (Kram, 1985; Ferris and Judge, 1991). Reskin's (1979) study on academic chemists suggests that the direct effect of mentoring is quite relevant during the early years of a scientist's career. Kirchmeyer (2005) obtains similar results for a sample of American academics.[5]

Another dimension of political capital may be provided by inbreeding and localism, the former to be intended as the tendency of a university to recruit new staff among the ranks of local graduates, the second as the more general tendency to fill professorial position through internal careers, as opposed to attracting scientists from other institutions (some overlap exists in the use of the two terms).

These phenomena may have economic origins. McGee (1960), through an investigation of the junior faculty of the University of Texas, finds that 29 per cent of the full-time professors had a University of Texas degree and justifies the use of inbreeding with financial reasons and geographical isolation. In this view, inbreeding can be seen as an efficient recruitment and promotion strategy, in proper circumstances. In some fields inbreeding may result from the scientists' choice: if laboratory life and long-term relationship are particular important, local candidates may prefer to wait for their "call" instead of applying for positions elsewhere. Finally, Bouba-Olga et al. (2008) justifies inbreeding as the consequence of the asymmetry information problem.

When it comes to empirics, however, Hargens and Farr (1973) find that, for scientists at their first academic job, no relationship appears to exist between inbreeding and scientific performance (either at the quantity or quality level); but for scientists at their second or successive career step, they find that those "who have been inbred throughout their careers [...] tend to be less productive" (Hargens and Farr, 1973, p. 1392). Hargens and Farr also look at the number of years it takes for an assistant professor to be promoted to an associate position, and find that inbred scientists wait for longer than others, even after controlling for differences in terms of productivity. Perotti (2002) documents a number of instances in which Italian selection committees preferred local candidates to much better qualified external ones. More generally, localism is denounced as a factor of backwardness in the academic systems of both France and Italy (Fréville, 2001; Schwartz, 2008; Abbot, 2006; Godechot and Louvet, 2008).

2.3. Social capital: a note on measurement with bibliometric data

Empirical attempts to measure social capital in science have made extensive use of social networks analysis, mostly based upon co-authorship and co-citation data (Crane, 1965, 1972; Mullins et al., 1977; Newman, 2001). Within this framework, a scientist's social capital may be associated to various measures of network *centrality* (for a general discussion of these measures see Freeman, 1979). Centrality measures, however, cannot disentangle the S&T-HU and the political dimensions of social capital; nor they can tell apart the direct and indirect influence on promotion, in the absence of controls for productivity. In fact, junior scientists working in association with influential mentors will tend to occupy a more central position in the co-authorship network than other colleagues of the same age and with similar productivity. As a result, it would be hard to say whether their higher promotion chances are explained, ceteris paribus, by the recruiters' consideration of their S&T-HU or by the influence exerted by their mentors on recruiters.

In order to provide distinct measures for the political form of social capital, one should be able to collect information both on the relationship between junior scientist and mentor (how strong the relationship is, and how much effort the mentor may be expected to put in place to support his/her *protégé*) and on the channels through which the mentor can exert his/her influence on the selection committees affecting the *protégé*'s career. This is tantamount to identifying the characteristics of mentors who we expect to be in the position to favor their *protégés*.

With respect to the strength of scientist-mentor ties, we find it useful to recall Coleman's (1988), notion of social capital as a form of "credit", which an actor can collect from another one at the right time:

> "If A does something for B and trusts B to reciprocate in the future, this establishes an expectation in A and an obligation on the part of B. This obligation can be conceived as a credit slip held by A for performance by B. If A holds a large number of these credit slips, for a number of persons with whom A has relations, then the analogy to financial capital is direct". [Coleman, 1988, p. S106]

In our academic setting, senior scientists' may contract obligations towards PhD students and junior affiliates who have helped them (among other things) to boost or maintain their publication record; and may be required to pay their debt by providing support to their co-authors' careers. PhD students and junior scientists, in

[5] Kirchmeyer (2005) considers a sample of 143 American academics who earned PhD and DBA degrees in accounting between 1984 and 1987.

fact, constitute the backbone of research teams, in the absence of whom no senior scientist can hope to produce significant research (on the increasing importance of teams in science, see Jones et al., 2008; Jones, 2009). This suggests to consider the extent of a senior's scientists obligations towards candidates to promotion as a key determinant of the latter's chances of success. This requires measuring the amount of the mentor's scientific production based upon the junior scientist's contribution.

As for the identification of channels of mentor's influence and of influential mentors, these depend heavily on the institutional specificities of the academic systems we are interested in. The (very few) suggestions contained in the literature point at the position of mentors in the boards of either top-ranked journals or important scientific societies. However, these are measures of a mentor's prestige, which can be crucial in an informal academic labor market such as the US one (in which reference letters are openly accepted and sought after) and no state-sanctioned disciplines or recruitment mechanisms are in place. But in France and in Italy, the two countries of our interest, reference letters do not play any formal role in the recruitment system, which is controlled by ministries of higher education through a complex web of regulations. In these two countries, what really matters are the mentor's academic rank and discipline, both being legal categories through which the state exerts its control over academia, while allowing for some self-regulation by academics. As a consequence, any measure of French and Italian scientists' political capital has to be grounded on an accurate understanding of the complex legal procedures that regulate academic careers in the two countries.

Finally, going back to Coleman's theory of social capital, it should be remembered that for credit to be collectable, agents involved in the exchange ought to belong to tightly knitted ("dense") social networks, so that failure to repay debts can be monitored and sanctioned effectively. French and especially Italian scientific disciplines fit this description. As discussed below, interactions among their members are frequent, not only for scientific purposes, but also for the purposes of managing all the complex legal procedures concerning academic life.

3. Academic careers in France and Italy

As one can easily gather from checking the references in the previous section, almost all the literature on academic careers derives from US scholars, whether economists or sociologists.[6] As stressed by many authoritative studies (Ben-David, 1977; Clark, 1993), however, the US system has unique features in terms of university autonomy and academic labor market mobility. US universities select candidates for professorial jobs in total autonomy, with no control from the central (federal) or state governments. Once selected, professors become university employees and can bargain for their wages and working conditions on an individual basis. In addition, the sheer number of US academic institutions, together with a competitive funding system, provide US-based scientists with a strong publication record with the opportunity to move from one university to another in search of better paid, or better funded research positions (Ehrenberg et al., 1991). Finally, the system is openly stratified according to the research vs. teaching intensity of academic institutions, and the latter's wealth: two- and four-year colleges follow different recruitment criteria than the 200 or so "research universities", and the latter differ widely in terms of financial resources, with private institutions most often being in a better-off position than the public ones.[7]

On the contrary, both the Italian and French academic recruitment processes consist of a mix of state control, professional corporatism, and a tendency to localism. As such they represent an extreme instance of a situation that is quite common throughout Europe. All French and Italian professors are civil servants, whose recruitment rules, duties and wages are fixed by national laws, and cannot be bargained at the local level, let alone the individual one. The French academic system has two main positions called "*Maître de conférences*" (MCF) and "*Professeur*" (PR). In Italy there are three positions called "*Ricercatore universitario*" (RU), "*Professore associato*" (PA) and "*Professore ordinario*" (PO). Here we are concerned mainly with career advancements, from MCF to PR in France, and from RU to PA in Italy. We do not investigate careers in public research organizations, such as the CNRS (*Centre Nationale de la Recherche Scientifique*) and the CNR (*Centro Nazionale delle Ricerche*), which follow different mechanisms.

Notice that access to a professorial position by an Italian *ricercatore* or a French *maître de conférences* cannot be considered, from the legal viewpoint, as a "promotion". In fact, legislation in both countries grants access to professorial positions only through recruitment calls, which are open to all qualified candidates, where the latter include (in principle) not only the *ricercatori* and *maîtres de conférences*, but also a large number of scientists from public research organizations and business companies, as well as foreign scientists. Nevertheless, moving to a professorial position from lower academic ranks is commonly perceived (and often referred to) as a promotion,[8] also because the vast majority of newly recruited professors in both countries come from the ranks of *ricercatori* and *maîtres de conférences*. So, in the remainder of the paper, we will use the term "promotion" when referring to the specific career event of our interest, namely the access to professorial positions by *ricercatori* and *maîtres de conférences*, but we will use the term "recruitment" when discussing the legal details that regulate such access, and any related concept.[9]

In both France and Italy, all academic positions are tenured, and for all of them salaries are defined by national laws. All academic personnel are classified by the government according to their discipline, with the latter best conceived as a legal concept. Disciplines fulfil a role similar to professional guilds: their members, and not individual universities or departments, retain the ultimate formal control over the recruitment process. By and large, this control is passed on to senior discipline members at the local level, while the

[6] Again, the main exceptions are the occasional self-referential studies by economists on the career prospects within their own discipline, such as Checchi (1999) and Perotti (2002) for Italy, or Combes et al. (2008) for France.

[7] Research universities are commonly identified as those granting PhDs, and are ranked according to a number of criteria. The original classification was proposed in 1970 by the Carnegie Commission of Higher Education, which has updated it since then (http://www.carnegiefoundation.org/classifications/).

[8] See, for example, the use of term "promotion" in an official report such as Schwartz (2008, p. 131).

[9] While the Italian system does not contemplate any sort of promotion, the French one actually does. Both MCFs and PRs can access to different "classes" within the same position. Access to higher classes depends largely on seniority and it has only economic consequences (Schwartz, 2008; pp. 65–67). In this respect, things are not different from Italy, where no such promotions exist, but salaries for each position increase steadily with seniority. Another step in French careers which is worth recalling consists in the "*habilitation à diriger des recherches*" (HDR), which is a legal title (obtained through a national procedures) that allows MCFs to act as thesis supervisors at the doctoral level, and is generally required as a pre-requisite to apply for professorial jobs. In order to get an HDR, the candidate has simply to prove some continuity in his/her scientific production over the years. However, getting an HDR does not affect a MCF's wage, nor his/her decisional power within departmental committees or other administrative bodies. Debates on academic careers in France often suggest that HDR is a purely bureaucratic step in a scientist's career, one that does not really discriminate among high- and low-quality candidates for professorial positions (for a description, see documentation prepared by the Guilde des Doctorands, an association of doctoral students: http://habilitation.rech.free.fr/, last visited on 22/7/2011). Sparse criticism can be found in Fréville (2001).

university administration at large has little say both on selection criteria and on the choice of candidates. With reference to France, a 2001 report to the Senate describes this situation as "autonomy of university bodies against autonomy of universities".[10]

In Italy, the disciplinary classification is very detailed, and it is negotiated periodically between the Ministry and the leading senior professors of the country. Over the past 20 years, the classification system has become larger and more fragmented, and at present it includes more than 170 disciplines for science, medicine and engineering alone.[11] After the mid-1990s and until the late 2010 (the time interval our data refer to), any university wishing to fill a vacancy or to offer a new professorial position had first to specify for what discipline the job was offered; then it had to launch a call for applications (*concorso*) and set up an examining committee. All the committee members must belong to the same discipline for which the position was offered; one of them was chosen by the university, most often from the internal faculty, and two to four others were elected with a national secret ballot by all professors ranked as high, or higher than the position on offer, in the selected discipline. Nominally, the commission did not have the task of picking the most suitable candidate for the university that launched the call (on the basis, for example, of a coincidence between the candidate's and the university's research interests), but the best possible candidate among all applicants, namely the one with the best publication record (called "idoneo", which means *fit-for-the-job*). In principle, if the university did not like this candidate, it could always refuse to nominate him/her and launch a new job call after a couple of years. In practice, this led to intense within-the-discipline negotiations in order to steer the secret ballot in the direction of selecting a majority of external commissioners on good terms with colleagues at the university issuing the call, and then selected as "idoneo" a local candidate.[12] In some job competitions, the commissions were also allowed to declare two winners (two *idonei*), which made negotiations easier.[13]

Such recruitment rules are currently under reform in Italy, after a decade of criticism levied against their inefficiency. Quite strikingly, the proposed changes goes very much in the direction of the French system, which has been criticized for the same reasons. We will come back to such reform in the conclusions.[14]

Disciplinary classification in France is less detailed than in Italy (no more than 70 state-sanctioned disciplines exist, including both hard and soft sciences), so that nation-wide negotiations such as those described for Italy may be harder to conduct. The recruitment of *professeurs* in physics (the discipline we consider in this paper) occurs through national competitions (*concours*), which unfolds over two phases (reforms of the second phase were introduced in 2007, but the two phase-structure has remained unchanged). Since 1992, the first phase, called "*qualification*", is centrally managed by the National Council of Universities (*Conseil National des Universités*, CNU), an overseeing body under governmental control. The second phase consists in the selection of candidates by individual universities. The government also exercises control by pre-selecting the universities that, on the basis on their economic conditions and size of student population, are allowed to create a new position or put a vacant one on offer.[15]

The CNU is divided into sections and each section is in charge of selecting the candidates who are "qualified" to apply for a professorial position in that discipline. Each CNU section comprises both members elected by the professors in the discipline, and members appointed by the minister (in a 2:1 proportion). All members serve for more than one year. Each year, the CNU releases a list of "qualified" candidates on the basis of their publication and teaching records.

In the second phase of the recruitment process, the qualified candidates apply for professorial jobs at local institutions (after four years, candidates who have not found a job lose their qualification). Until 2007, each university trusted this phase to local recruitment committees (*commissions de spécialistes*) whose task consisted in evaluating the applicants, one for each discipline (or groups of related disciplines in smaller universities). The committees, elected every four years, were composed of members of the faculty and possibly invited members from other institutions. After a major reform of 2007, these committees have been placed under stricter control by the university president.[16]

So, the main legal difference between Italian *concorsi* (before 2010) and French *concours* (before 2007) lied at the qualification stage. While French candidates got their professorial qualification through a committee which was both national and under some degree of ministerial control, in Italy the qualification had to be obtained navigating through the many elective commissions scattered across the individual universities. Besides, qualification in France was less linked to the availability of professorial jobs (the number of qualification certificates not being linked to the number of vacant positions). At the same time, the two systems show similarities when it comes to the ultimate choice of candidates, as local affiliates to the relevant discipline exerted (and still exert) strong control on it in both countries, albeit possibly stronger in Italy than in France.[17] This situation may be due to the civil servant status of professors in both countries: a professor's salary growth over time does not depend upon the university's decision, but is

[10] Literally: "L'autonomie des corps universitaires contre l'autonomie des universités" (Fréville, 2001; p. 57).

[11] Overall there are no less than 300 disciplines; some of them, such as "Naval Architecture" and "Naval and Marine Engineering" – notice they are considered separately – counted less than 30 affiliates in 2005. Efforts to revise the classification and makes it more compact have been under way for more than a decade now, with no success in sight.

[12] Once that result had been achieved, the commissioners would take care of letting several candidates know their presence would be an embarrassment to the commission (these were typically those candidates with a strong publication record, but not considered keenly by the university issuing the *concorso*). On the long-standing importance of such practices in the Italian academic system, see Clark (1977); on their perpetuation to present days see Simone (2000), Perotti (2008), and Gardini (2009).

[13] In this way, the examining commission was free to let both the strongest candidate and a local insider win. Then the latter would then be chosen for the job, and the former possibly called by some other university. A controversial rule, in fact, allowed fit-for-the-job (*idonei*) candidates, who had not been recruited by the university issuing the call, to be offered a job position by other universities, without a new "concorso". Needless to say, this possibility was often exploited for more political bargaining among the professoriate: external commissioners would agree to trade the nomination of a local candidate, in exchange for a 'fit-for-the-job' certificate for another candidate, who they wished to recruit in their own university.

[14] It is worth stressing that reforms of the recruitment systems have been produced incessantly in both countries over the past 30 years, but have never changed the core of the systems themselves, such as the civil servant status of academic staff, the importance of centralized regulation of job calls and staff's duties and wages, as well as the overarching importance of disciplinary affiliation (Musselin, 2005; Simone, 2000; Potestio, 2009).

[15] Recruitment procedures for professors are the same of all other disciplines, with exception of the legal, economic, and political ones. For a detailed description of such rules before 2007, see Fréville (2001; section III). For an update to post-2007 rules, see Schwartz (2008; section 1.2) and the conclusions of this paper.

[16] The reform was the result of a major legislative change aimed at granting more autonomy to universities (also with respect to the professoriate) and at introducing more competition for economic resources (*Loi relative aux libertés et responsabilités des universités*, also known as *Loi Pecresse*, from the name of the ministry who drafted it). See: Barthelemy et al. (2008) and Vinokur (2008). We will come back to it in the conclusions.

[17] The extent at which local control translate into localism of recruitment vary by discipline. In France, for example, localism is not an issue in mathematics since 2000, although it is very common in most other disciplines (Schwartz, 2008; pp. 51–52 and 125–126) and was not so uncommon also in mathematics before 2000 (Godechot and Louvet, 2008, pp. 14–16).

determined by law and linked exclusively to seniority; universities have no power to fire absentee professors, or to moderate the balance between their research and teaching duties according to the university's needs (teaching loads are also determined by law). So, brilliant scientists from top universities (or foreign ones) may be seen by peripheral and teaching-oriented universities as a threat: once recruited, they could try to spend as little time as possible locally, in order to maintain informal research ties with their *alma mater* (Musselin, 2005). Accordingly, more peripheral universities will have many incentives to play the system in order to push forward their internal candidates, rather than recruiting external ones.

4. Analytical statements, data and model specification

4.1. Proposed analysis

The examination of the recruitment process in the two countries suggests some hypotheses on the factors affecting academic careers in France and Italy, as derived from the literature we examined in Section 2, the administrative framework we described in Section 3, and a few other characteristics of the scientific infrastructure of the two countries, which we will recall here.

A candidate's career length, in principle, should not affect his/her promotion chances, since seniority does not enter the examination criteria of either the French or Italian systems. On the contrary, productivity should matter decisively in both countries, as the selection committees are first and foremost concerned with evaluating it. However, the literature suggests that seniority matters, especially for local candidates.

The egalitarian norms typical of French and Italian legislations forbid the consideration of departmental prestige as a factor to be evaluated by the selection committees: all PhD titles ought to be considered equal, since no official ranking of universities or department exists, and no unofficial information can be deemed as relevant by examiners. Both in France and in Italy, however, departments may be ranked according to the strength of their ties to the two largest public research organizations, respectively the CNRS and the CNR. The ties to such research organizations allow scientists and departments to use knowledge and resources produced outside the university border, and thus are to be considered part of S&T-HU capital as discussed in Section 2.2.

In France, the CNRS has traditionally played a more important role in research than universities. It receives the largest portion of research funds from the government, some of which it redistributes to academic scientists via collaborations and partnerships. However, since the 1970s, policy-makers have pushed for a better integration of the CNRS and academic research structures (Mustar and Larédo, 2001). Nowadays, the CNRS operates mainly through laboratories located within universities, and universities compete to host such laboratories.[18]

In Italy, CNR laboratories do not, in general, have the same importance as their CNRS equivalents. However, in physics, the CNR often controls key research tools and infrastructures, so that participating in its research programmes may be a necessary precondition for conducting top quality research. In material physics, a similar role is played by the INFM (*Istituto Nazionale di Fisica della Materia*), a research organism that was for a long time independent of CNR (it was absorbed by the latter only in 2005, after the time period considered in this paper). The INFM operated via a network of laboratories, all except one located within different universities and staffed by academic personnel. Such a *modus operandi* created a hierarchy not dissimilar to the one we described above for the CNRS in France, although less visible and, possibly, less decisive.

As for gender, no apparent reason exists to think of peculiarities for France and Italy with respect to the US-based evidence at hand. A quick look at available statistics show that women are under-represented in both academic systems, especially at the professorial level (see also Sabatier et al., 2006). So we suspect that gender will affect a candidate's chances of advancement.

Finally, as far as political capitals is concerned, mentoring, in principle, should have no role, as no reference letters are admitted in the recruitment processes we examined in Section 3. However, in the Italian system, mentors may either lobby in order to be elected into the examination committee, or ensure that some close colleagues of theirs are elected in their place, so they can exert direct influence on the recruitment process. In France, this result is also possible but it may be harder to achieve, at least at the national level, as the CNU is not entirely elected, and the disciplines are too large for their members' voting intentions to be easily steered.[19]

Following the discussion in Section 3, we expect localism to play an important role in both countries. Again, according to legal principles, it should not be so, but in practice all departments in peripheral universities face the problem of fending off candidates who, although qualified, would not be dedicated to the institution; while departments in major institutions may consider candidates from lesser ones to be inadequate. In this sense a candidate with stronger links within his/her own university could be preferred by the local commission. Indeed, the centralized and disciplinary-based academic system of both Italy and France suggests that this political dimension may have an important role in shaping careers. Prospective candidates for professorial positions have an incentive to nurture ties with senior members of their discipline, not (only) for the purposes of information sharing and knowledge creation, but (also) because the latter will be very likely to sit in their examination boards. This ought to be especially true of Italy, where both stages of the recruitment process are in the hands of local committees.

When attempting to measure the importance of junior scientists' social capital, we will therefore distinguish between contacts that have the potential to increase a scientist's productivity (S&T-HU, as defined in Section 2) and those of a political nature, that serve the purpose of linking up with decision-makers at a disciplinary level. For the latter, we will resort to a measure that operationalizes Coleman's concept of "credit", also discussed in Section 2.

4.2. Data

Our dataset contains information on Italian and French academic physicists active in the academic year 2004/2005, which we obtained from the Ministries of Education of the two countries. Due to the need to reconcile differences in the French and Italian discipline classification system, we exclude from the analysis nuclear

[18] CNRS laboratories within universities take generally the form of *Unités Mixte de Recherche* (UMRs), which are staffed by both CNRS and university personnel, To these one should add the (very few) *Unités Propre de Recherche* (UPRs), which are staffed only by CNRS personnel. Both types of laboratories have more means and prestige than laboratories staffed by university personnel only, with little or no access to CNRS funds. In the life sciences, the role of the CNRS co-exists with that of INSERM (*Institut National de la Santé et de la Recherche Médicale*). Similarly, in more applied disciplines other public research organizations play a similar role (as is the case of INRA, *Institut National de la Santé et de la Recherche Médicale*, for agricultural studies). We focus on the role of the CNRS due to its dominant influence on physics, to which our data refer.

[19] One French physicist who commented on a previous draft of the paper suggested that, however, the CNU may be subject to influence by university trade unions, which may create difficulties for foreign scientists applying for professorial positions.

Table 1
Promotion and mobility.

	France			Italy		
	Total	Men	Women	Total	Men	Women
No. of scientists [MCFs-France; RUs-Italy]	813	599	214	469	365	104
Promoted*, no. and % over no. of scientists	109 (13.4%)	94 (15.7%)	15 (7%)	211 (45%)	172 (47%)	39 (39%)
Mobile**, no. and % over promoted	22 (20%)	19 (20%)	3 (20%)	12 (5.7%)	11 (6.4%)	1 (2.5%)

* MCFs and RUs promoted to professorial positions (aged between 30 and 50).
** MCFs and RUs who changed university affiliation when promoted.

physicists and astrophysicists.[20] We concentrate on rank advancements between 2000 and 2005 for Italy, and between 2000 and 2003 in France.

Since a direct comparison between the careers of academic scientists in the two countries cannot be made without an aggregation of two of the three Italian positions, we decided to run and compare separate regressions for the promotions of French MCFs and Italian RUs to professorial positions (PR in France and PA in Italy; Model 1).[21] The dependent variable is a dummy that takes value one if we observe that the scientist has been promoted by the end of the observation period. We also run a subsidiary regression for promotion from PA to PO, which applies only to Italy (Model 2).

The choice to compare French MCFs and Italian RUs is justified by the similarity of the two positions. In particular, access to the two positions occurs roughly at the same age (33 years, on average; see Table A1 in Appendix A), which allows us to consider them a uniform starting point for admission to higher ranks. However, the age structure of MCFs and RUs is not the same, the former usually being younger than the latter (see below). Therefore, in order to increase comparability, we excluded from both the MCF and RU samples those scientists who were either too young or too old to be considered for promotion, namely those younger than 30 or older than 50.[22] This leaves us with a sample for Model 1 of 1282 scientists (813 French and 469 Italians). Of these, less than 14% were promoted to a professorial position in France, as compared to 45% in Italy, with differences across disciplines for Italy (see Table 1 and Table A2 in Appendix A). Most of the promoted scientists did not change affiliation after promotion: only 20% changed university in France, and less than 6%in Italy. Some gender gap also appears to be significant, and it is more visible for France.

As for Model 2, our sample includes 578 Italian PAs, of which 184 were promoted to a PO position.

Notice that we cannot observe whether MCFs or RUs (or PAs) actively sought promotion during our observation spell, that is whether they applied to enter a *concorso* or *concours*. We just consider that all MCFs and RUs (and PAs) were potential candidates. For sake of simplicity, therefore, we will often use the term "potential candidate" when discussing the explanatory variables we produced. These variables can be grouped into three classes: individual characteristics (including productivity), S&T-HU capital, and political capital. A complete list is reported in Table 2.

Table 2
Career determinants (explanatory variables for promotion).

2a. Productivity and individual characteristics	
Gender	Gender dummy (=1 for women scientists)
Age	Scientist's age in year 2000
Productivity	Cumulative sum of impact factors of the journals where articles are published, weighted by the number of co-authors (see Eq. (1))
2b. Scientific and technical human capital	
CNRS	Percentage of affiliations which list at least one CNRS researcher
CNR	Percentage of affiliations which list at least one CNR researcher
INFM	Percentage of affiliations which list at least one INFM researcher.
Collaboration with a star	Percentage of articles published between 1995 and 1999 which list at least one CNRS or UMR affiliation, for each scientist i
US	Percentage of affiliations which list at least one US researcher
2d. Political capital	
Credit	Weighted sum of ties with PO or PR, where the ties are a co-publication and the weight is 1 over the total number of PO/PR's articles
Uni_connection	Share of candidate's publications with full professors from the same university over the total number of his own publications

4.2.1. Individual characteristics

As discussed in Section 2, according to both the Italian and French legislation, scientific productivity ought to be the key determinant for career advancement. In physics, it is most common to measure productivity by counting publications in international scientific journals, possibly weighted by the number of authors and the impact factor of the journal. Therefore, we extracted from ISI-Web of Science© all the scientific articles published between 1975 and 1999, in physics journals with a 5-year impact factor of at least 0.5, and authored by at least one individual in our samples.[23]

We do not include in our models distinct measures of quality and quantity of publications, but we use a summary index that accounts for both these features. In detail, we weigh each publication for the impact factor of the journal and for the number of authors, as shown

[20] The disciplinary fields we considered, as described by the extant classifications, are, for France: *Milieux denses et materiaux* (28) and *Milieux dilues et optique* (30); for Italy: *Fisica Sperimentale* (Fis/01), *Fisica Teorica, Modelli e Metodi Matematici* (Fis/02), *Fisica della Materia* (Fis/03) (codes in brackets are from the respective national classification systems). Other physics-related fields which are present in the two countries' classification system, and which we excluded, are, for France: *Constituants elementaires* (29) and *Astronomie & Astrophysique* (34); and, for Italy: *Fisica Nucleare e Subnucleare* (Fis/04), *Astronomia e Astrofisica* (Fis/05), *Fisica per il Sistema Terra e il Mezzo Circumterrestre* (Fis/06), *Fisica Applicata* (Fis/07). For Italy, we also did not consider a number of classes within the engineering disciplines. Notice, however, that in Italy several nuclear physicists, following a decrease in the number of position offered in Fis/04, managed to move into Fis/02 and Fis/03, while still publishing in their original fields.

[21] Direct advancements from RU to PO, in Italy, are legally possible but practically non-existent.

[22] Following a referee's request, we have also considered a sample without this limitation. Our results do not change (they are available on request).

[23] For the definition of impact factor, see Garfield (1972). We considered the average 5-year impact factor of each journal, since it was first recorded in the ISI database. On average, we observed the impact factor of each journal for a period of 13 years. The complete list of selected journals is available on request. Notice that, following a referee's suggestion, we estimated models which include also the publications with an impact lower that 0.5, but our results did not change. Notice also that by selecting journals specialized in physics, we leave out generalist journals such as *Science* and *Nature*. Considering them would generate intractable problems of homonymy, being it impossible to distinguish articles authored by physicists in our samples from articles authored by homonym scientists from different disciplines or countries.

Table 3a
Descriptive statistics (MCF, France).

	Obs.	Mean	Standard deviation	Min	Max	Median	90° percentile
Individual covariates							
Gender	813	0.26	0.44	0	1	0	1
Age	813	36.37	4.77	30.00	50	35	43
Productivity	813	18.07	34.86	0	563.40	10.24	38.97
Articles	813	13.70	30.73	0	373	8	24.00
Scientific and technical human capital							
CNRS	813	0.27	0.27	0	1	0.22	0.66
Collaboration with STARS	813	0.36	0.48	0	1	0	1
US collaborations	813	0.01	0.06	0	0.56	0	0.28
Political capital							
Credit	813	0.10	0.19	0	1.35	0.03	0.31
Uni_connection	813	0.17	0.29	0	1	0	0.7

Table 3b
Descriptive statistics (RU, Italy).

	Obs.	Mean	Standard deviation	Min	Max	Median	90° percentile
Individual covariates							
Gender	469	0.22	0.42	0	1	0	1
Age	469	40.00	4.75	30.00	50	39	47
Productivity	469	53.47	50.14	0	326.67	39.28	125.25
Articles	469	43.06	49.80	0	290	29	87.00
Scientific and technical human capital							
CNR	469	0.20	0.16	0	1	0.16	0.42
INFM	469	0.06	0.11	0	1	0.002	0.2
Collaboration with STARS	469	0.49	0.50	0	1	0	1
US collaborations	469	0.02	0.05	0	0.57	0	0.07
Political capital							
Credit	469	0.22	0.28	0	1.78	0.12	0.61
Uni_connection	469	0.19	0.27	0	1	0.03	0.63

in Eq. (1), which refers to scientist i between the time interval (t_0, T):[24]

$$\text{Productivity}_{i,T} = \sum_{t=t_0}^{T} \sum_{a=0}^{N_{i,t}} \left(\frac{imp}{aut} \right)_a \quad (1)$$

where articles are indexed from $a = 0$ to $a = N_t$, and:

- $N_{i,t}$ is the number of articles signed by scientist i *in year* t
- t_0 is the year of the first publication, and T is 1999
- imp_a is the impact factor of the journal where article a is published
- aut_a is the number of authors of the article a.

This measure takes into account also the "zero cases", i.e. the potential candidates with zero publications during the whole career (1.71% of all cases in Italy and 10.29% in France).

Tables 3a and 3b report descriptive statistics for all the covariates, for both countries. They show that, whatever adjustment we introduce to control for scientific productivity, Italian scientists appear to be more productive than their French colleagues (see Lissoni et al., 2011, for a study of the determinants of productivity in the two countries).

Other variables of interest at the individual level are age (which we treat as a proxy for the scientist's career length[25]) and gender. Tables 3a and 3b show that French MCFs are on average younger than Italian RUs, even if they reach that position (on average) at the same age of 33 (see Table A1 in Appendix A). This is due to the higher recruitment rates of MCFs than of RUs.[26]

4.2.2. Scientific and technical human capital

We measure S&T-HU capital by means of a set of variables based upon information on potential candidates' affiliation, as derived from the ISI-Web of Science records.[27] Each ISI record lists, in separate fields, the authors' names, and their affiliations at the department or laboratory level, with information on whether the department/laboratory is affiliated to the CNRS for France, and the CNR or INFM for Italy. Unfortunately, there is no one-to-one correspondence between names and affiliations. As a consequence, we cannot derive from publication records the exact affiliation of each scientist; at most, we can say that either the author of our interest and/or one of his/her co-authors are affiliated to CNRS, CNR or INFM. However, this is still quite a useful piece of information, because at the very least it signals some connection between such institutions and the scientists of our interest.[28]

[24] We also experimented with the simple count of publications (*Articles*) over the time interval (t_0, T), a measure that does not take into account the number of co-authors nor the impact factor of journals. The correlation between these variable is high and significant (results are available on request). Similarly, we experimented with the total number of citations received up to 2008 (our data do not allow us to classify citations according to the year of publication of the citing article) in order to account for the quality. When we introduce separate regressors for quantity (articles) and quality (citations) the latter plays a positive role only in France (results available on request).

[25] The proper measure for seniority should be the time since recruitment (as MCF or RU). Unfortunately we do not have explicit information on it. We tried anyway to estimate it by calculating the difference between 2000 and the year of the candidate's first publication. However, this measure has quite a high and significant correlation with age (26% and 57% respectively for France and Italy) and never turns out significant when included in the regressions.

[26] Italian RUs are, on average, older than French MCFs because many of them were recruited in 1980, when an exceptional recruitment wave occurred, followed by a long draught (during which almost no *concorsi* were issued). In France, on the contrary, academic recruitment has been more regular, with the only exception of years around 1985 (see Lissoni et al., 2011).

[27] Our lists of scientists, obtained from ministerial records, also list the scientists' affiliation, but only at the university level. That is, they do not provide information on the specific department to which the scientist is affiliated, nor on the association between such departments to the large public research organizations from which prestige and resources may derive.

[28] In particular, for France, affiliation information may contain references to either the CNRS or UMR, which signal respectively the presence of a CNRS laboratory

For France, we build a *CNRS* variable, which represents the percentage of CNRS affiliations over the stock of affiliations listed in the scientist's publications (from the beginning of their career to 1999). Similarly, for Italy, the *CNR* and *INFM* variables measure the percentage of CNR or INFM affiliations.

Moreover, in order to capture the reputation effect, we build a dummy variable named *Collaboration with Stars*, which takes value one if the potential candidate has co-authored at least one paper with a scientific star during his/her career. A star is defined here as any physicist, from either France or Italy, in the top 10th percentile of the scientific productivity distribution in the two countries, as measured by per capita publications. Notice that, due to the national dimension of our databases, we cannot identify international stars, but only national ones (although we may presume that, due to the global connections of both the French and Italian physicists' communities no national stars can be unconnected to international ones). To correct for this, we consider an additional indicator of reputation, the *US* variable, which measures the percentage of US affiliations listed in all the potential candidate's articles, which we use as a proxy for a potential candidate's connections to the US scientific network.

Among the variables related to S&T human capital, the US literature we surveyed in Section 2 pays particular attention to the prestige of the PhD-granting institution. Unfortunately, this type of information is hardly available for France and Italy, so we identified the 4 top universities in physics in each country (according to ARWU, 2009) and checked whether they showed up as affiliation in the potential candidate's first publication. However because of its fragility and because it never turns out to be significant in our regressions, we do not report the results of model specifications including this measure (they remain available upon request).

4.2.3. Political capital

For what concerns the political capital, we try to capture it by means of *Credit*, a variable modeled upon Coleman's definition of social capital. This measures the strength of the relationship between a potential candidate to a professorial position and the professors (PRs or POs) in the same discipline (where disciplines are narrowly defined, as in footnote 20). *Credit* of potential candidate i is then measured as:

$$Credit_i = \sum_{j \in PR,PO_i} \left[\frac{co\_Articles_{i,j}}{Articles_j} \right] \quad (2a)$$

where $co\_Article_{i,j}$ is the number of publications jointly signed by candidate i and professor j together until 1999, and $Articles_j$ is the total number of publications by professor j in the same years. The logic of the measure is as follows: professors whose scientific production owes considerably to a junior colleague's co-authorship may be expected to repay their debt by making an effort to be elected as a member of the selection committees for PR or PA positions, in order to support the junior colleague's application; and/or by exerting their influence in order to obtain the election of trusted colleagues, who will then act in the same direction. That is, MCFs and RUs who manage to make themselves useful to one or more PRs and POs hold an asset ("Credit") to be repaid by mentoring and political.

We made attempts to control for conventional measures of positioning in social networks, as measured by co-authorship ties (such as degree centrality and in-betweenness), but none of these measures turned out to be significant when introduced in the regression alongside with *Credit*, and just a few of them reached 90% significance when introduced instead of *Credit*. So we do not dwell on these variables here (but results are available on request).

As for the importance of localism, we consider each potential candidate's share of publications with full professors of physics from the same university ("*Uni_connection*"). The professors we consider here are not only those classified in the same discipline as the candidate's, but also those in the other physics-related disciplines. This is because, at the local level, some cross-discipline exchanges may occur, as in France (where *commissions des spécialistes* may be composed of members of different, but related disciplines), but also in Italy, as long as members of one discipline may engage in negotiations with members on another, when it comes to sharing resources or drafting students' curricula.

Potential candidate i's *Uni connection* is measured as:

$$Uni\_connection_{i(U)} = \sum_{J(U) \in PR,PO_i} \left[\frac{co\_Articles_{i,j(U)}}{Articles_{i,t}} \right] \quad (2b)$$

where $co\_Article_{i,j}$ is the number of publications jointly signed by potential candidate i and professor j (who belongs to the same university U of potential candidate i), while $Article_{i,t}$ is the total number of publications of scientist i until 1999.[29] Notice that we do not distinguish here between the various subfields of physics that, especially in the Italian system, amount to separate disciplines and examination committees. What matters here is not the discipline, but the institution.

Finally, for both Italy and France, we consider that disciplines compete for resources at the national level, and control for cross-disciplinary differences in the availability of new jobs and promotion opportunities, by inserting in all regressions a dummy variable for each discipline.

4.3. Model specification

Promotion is a binary realization of the dependent variable y_i, where i is the individual. We run separate Logit regressions for France and Italy.[30] In principle, the ideal econometric method for studying promotion would be survival analysis (event history analysis), but our data are not appropriate for this type of exercise. In fact, we observe our potential candidate only for a short time span (5 years and 3 years, respectively for Italy and France) and we have information only on the year of promotion, not on the exact date (i.e. day and month). Besides, at least in Italy, many months may pass between the date when a commission decide about a potential candidate, and the date of official nomination by the university's administration so that the nomination date would hardly reflect the promotion date.

Logit coefficients cannot be readily interpreted as partial derivatives, so we produce ad hoc calculations of marginal effects with the help of several graphs, and place special emphasis on comparisons between the two countries. Tables in Appendix A report the correlation matrixes for all the covariates. No variable shows problems of high correlation, except for our measures of political capital,

within the university or of a mixed CNRS-university research unit (see Section 3). As for Italy, any mention of the CNR in the affiliation field of an academic scientist's publication record signals most often the presence, among co-authors, of one or more CNR employees. Also for Italy, any mention of INFM may signal that either the author and/or one or more co-authors are academic scientists working for an INFM-affiliated laboratory.

[29] An alternative control we experimented with was the number of international affiliations for each researcher's paper over a 5-year window, from 1995 to 1999. This variable however was never significant, nor it affected the estimated marginal effects of all other covariates, so we chose not to report the results of regressions including it (but they are available upon request).

[30] We have also run a number of linear probability (OLS) regressions, and checked that the resulting estimating coefficients do not differ much from the marginal effects as calculated from the Logit coefficients. We also applied Probit models, with no appreciable differences in the results.

Table 4
Logit model for promotion RU → PA and MCF → PR 2000–05 (Italy) and 2000–03 (France); individual, S&T human capital and political capital determinants.

	(1) France	(2) Italy	(3) France	(4) Italy	(5) France	(6) Italy	(7) France	(8) Italy	(9) France	(10) Italy
Gender	−0.78***	−0.20	−0.73**	−0.21	−0.77**	−0.21	−0.74**	−0.22	−0.73**	−0.27
	(0.30)	(0.25)	(0.30)	(0.26)	(0.30)	(0.26)	(0.30)	(0.26)	(0.30)	(0.26)
Age	1.08***	1.80***	1.04***	1.87***	1.08***	1.89***	1.03***	1.92***	1.02***	1.87***
	(0.34)	(0.37)	(0.34)	(0.38)	(0.34)	(0.38)	(0.34)	(0.38)	(0.35)	(0.38)
Age^2	−0.01***	−0.02***	−0.01***	−0.02***	−0.01***	−0.02***	−0.01***	−0.02***	−0.01***	−0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Productivity	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01**	0.01***	0.01**	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Field == F01/F30	0.044	1.11***	0.049	0.89**	0.043	1.21***	0.046	0.96***	0.043	1.00***
	(0.23)	(0.35)	(0.23)	(0.37)	(0.23)	(0.36)	(0.23)	(0.37)	(0.23)	(0.37)
Field == F03		1.03***		0.83**		0.94**		0.80**		0.80**
		(0.37)		(0.38)		(0.38)		(0.38)		(0.38)
CNR/CNRS	0.77**	−0.89	0.74*	−1.57**	0.75*	−1.28*	0.76*	−1.62**	0.77*	−1.71**
	(0.39)	(0.74)	(0.39)	(0.79)	(0.39)	(0.77)	(0.39)	(0.80)	(0.39)	(0.80)
INFM		1.57		0.96		0.58		0.58		0.44
		(1.00)		(1.04)		(1.07)		(1.08)		(1.09)
Collaboration with STARS			0.090	0.27	0.18	0.12	0.13	0.15	0.13	0.16
			(0.24)	(0.23)	(0.23)	(0.23)	(0.24)	(0.23)	(0.24)	(0.24)
US collaborations			−1.00	−2.95	−1.13	−2.26	−0.98	−2.65	−0.93	−2.72
			(2.30)	(2.07)	(2.29)	(2.04)	(2.29)	(2.07)	(2.29)	(2.07)
Credit			0.46	1.39***			0.75	1.07***	0.73	1.08***
			(0.51)	(0.39)			(0.58)	(0.41)	(0.58)	(0.41)
Uni_connection					−0.17	1.39***	−0.45	0.98**	−0.40	1.19**
					(0.39)	(0.41)	(0.45)	(0.44)	(0.45)	(0.46)
Uni_connection × Top Universities									−0.78	−1.80*
									(1.72)	(1.03)
Constant	−24.2***	−38.6***	−23.5***	−39.8***	−24.1***	−40.7***	−23.1***	−41.1***	−23.0***	−40.2***
	(6.62)	(7.56)	(6.64)	(7.68)	(6.63)	(7.75)	(6.64)	(7.79)	(6.66)	(7.82)
McFadden's R2	0.081	0.11	0.083	0.137	0.082	0.134	0.085	0.145	0.086	0.146
Observations	813	469	813	469	813	469	813	469	813	469

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

namely *Credit* and *Uni_connection*. As a consequence, we have considered several specification of the model, one of which includes both *Uni_connection* and *Credit*, and two of which allow for either one of the two. As we will see, both variables maintain their sign and significance in all specifications, albeit their estimated coefficients vary slightly.

5. Results

5.1. Individual determinants and S&T human capital

Regression results in Table 4 are generally in line with the evidence we reviewed in Section 2, but we notice some interesting differences between France (odd-numbered columns) and Italy (even-numbered columns).

Age has a significant and non-monotonic impact on the scientists' promotion chances in both countries, in all the specifications considered. The effect of age on the probability of promotion has a concave shape, with an initial increment and a gradual decline, as scientists' age increases. This result is close to what was found by Long et al. (1993) for seniority.

Gender has a negative impact on promotion chances in both countries, but it is statistically significant only for France. Being a female physicist in France means having half the chances of promotion than a male colleague, other things being equal, whatever specification of the model we consider.

Fig. 1 is a conditional effect plot, based upon specifications (1) and (2) in Table 4. It compares French and Italian potential candidates' promotion probabilities, conditional on age and gender (all other variables set at mean value, or zero for dummies). We notice that the marginal effect of age on promotion is higher in Italy than in France, as witnessed by the different inclination of the curves. The position of the promotion probability curves for Italian scientists of both genders is persistently higher, due to the fact that many more Italian RUs are promoted to PA positions, than French MCFs are promoted to PR (this, in turn, is due to easier access to PA positions than to PR positions, and to the longer time interval over which we observe promotions in Italy, 5 years against the 3 for France).

We can also calculate (on the basis of the estimated coefficients) that the probability of promotion at the age of 40 for an average

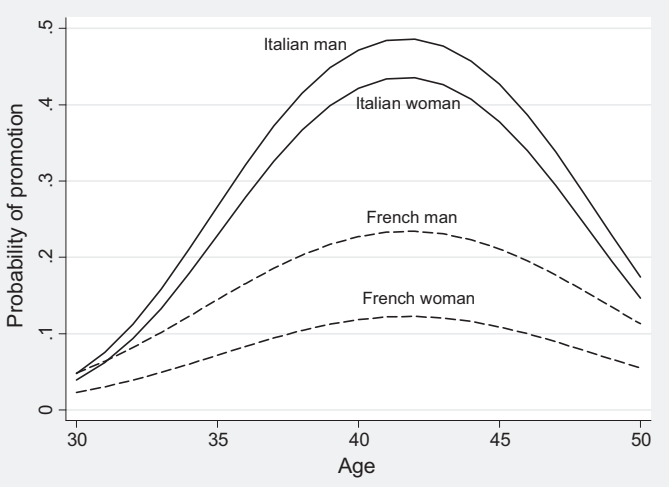

Fig. 1. Promotion probabilities as a function of age and gender*, France (promotion from MCF to PR) and Italy (RU to PA). Notes: Marginal effects calculated on the basis of regressions (1) and (2) in Table 4 All other regressors besides gender and age are set at avg. values.

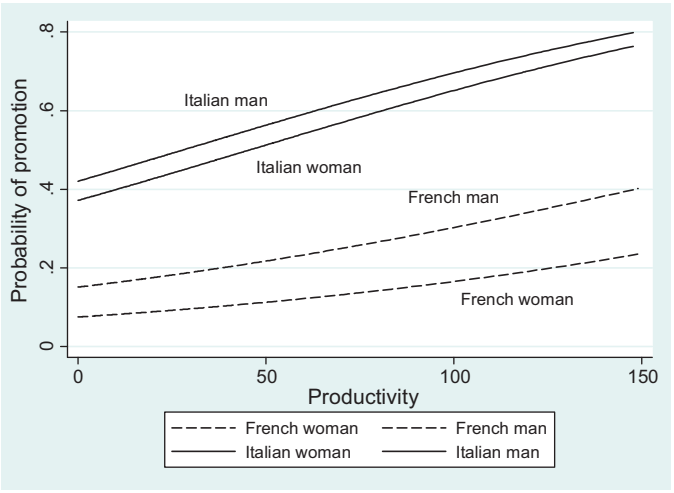

Fig. 2. Promotion probability as a function of productivity and gender*, France (promotion from MCF to PR) and Italy (RU to PA). Notes: Marginal effects calculated on the basis of regressions (1) and (2) in Table 4. All other regressors besides gender and productivity are set at avg. values.

Italian physicist[31] is about 47%, while it is only 22% for the average French physicist at the same age.

As for gender, a note of caution is due. Our data cannot tell whether a scientist does not get promoted because she fails a *concorso* or *concours*, or because she does not even try it. So it may either be that French examination committees discriminate against female scientists, but also that the latter self-select themselves out of the competition for top jobs (for example, by not even trying to obtain the *qualification*). It remains to be seen whether the two explanations are complementary (women scientists do not even try to enter a competition, as they are bound to lose) or alternative (women scientists decide that, for many possible reasons, that they do not want to get a professorial job).[32]

Scientific productivity has a positive impact on the probability of promotion, much higher in Italy than in France. Estimates in columns (1) of Table 4 suggest that one additional single-authored publication (on a journal with an impact factor equal to one) will increase the average French potential candidate's promotion probability by 0.13%. As for Italy, the equivalent probability we derive from column (2) of the same table is 0.28%. These figures do not change much when we consider alternative specifications.

Fig. 2 is a conditional effects plot similar to Fig. 1, which represents the probability of promotion conditional to productivity and gender, based upon specifications (1) and (2) in Table 4. It shows that for all scientists the probability of promotion, despite increasing monotonically with productivity, incurs into diminishing returns. We explain this result with the possibility that a few highly productive scientists do not get promoted because they opt for a career outside their home country or outside university (for example, in public research organizations).

Having a high percentage of *CNRS* contacts enhances a French scientist's probability to be promoted. Calculations of the marginal effect on the basis of specification (1) suggest that a difference of 1% more CNRS connection add 0.11% to the promotion probability of the average French scientist. However we have to be careful in interpreting this variable because we are not able to distinguish potential candidates with a double affiliation (to their university and some CNRS-funded laboratory) from those who merely collaborate with CNRS scientists. It is only in the second case that we could consider the CNRS variable as a proxy of S&T human capital.

Coming to Italy, the *CNR* variable bears a negative sign, a result which is unexpected.[33] The only explanation we can provide relates to the increasing weakness of *CNR* as a scientific powerhouse, whose influence on the national scientific system has decreased over time, and in any case has never achieved the same importance of CNRS for France. As for the other major Italian public research organization in physics, INFM, we notice that co-authorship affiliation to it has a positive, but not significant impact on Italian scientists' promotion chances.

In neither countries our measures of reputation-oriented social capital affects significantly the probability to be promoted. Collaborating with the most productive national scientists (*Collaboration with Stars*) seem to have a positive effect, but the coefficient is never significant. Surprisingly, the collaboration with *US* scientist seems to play a negative effect (although not significant): a possible explanation is that some potential candidate with US contacts may look for a US career instead of a national one.

Finally, while promotion chances in France do not depend on the specific discipline to which a physicist belongs (the discipline dummies are not statistically significant), the opposite is true for Italy. Due to the high variability of average promotion chances across Italian disciplines, disciplinary affiliation matters a great deal for a scientist's career. If in France the promotion probability are roughly the same in both the fields (13% in Milieux denses et matériaux and 14% in *Milieux dilués et optique*), while in Italy it is more than 50% in *Fisica della Materia* (Fis/03), around 45% in *Fisica Sperimentale* (Fis/01) and around 33% in *Fisica Teorica, Modelli e Metodi Matematici* (Fis/02) (see Table A2 in Appendix A). These differences reflect the relative number of positions offered in each field, as a consequences of policy choices.

5.2. Political capital

Specifications in columns 3–10 in Table 4 include not only our measures of S&T-HU capital, but also those for political capital. We notice that the estimated coefficients of the former are not sensitive to the introduction of new explanatory variables, due to limited correlation (see Tables A3a and A3b in Appendix A).

Political capital affects promotion chances, but only of Italian perspective candidates. In columns (4) and (6) we consider *Uni_connection* and *Credit* separately, while in specification (8) they are considered jointly: the change in the estimated coefficients from (4) and (6) to (8) is a reminder of their high correlation, which however does not cancel away the effect of either. The importance of *Uni_connection* is a reminder of the low rate of mobility in the Italian system, which matches the indication coming from descriptive statistics about the virtual impossibility for any scientist to be promoted and at the same time to change university.

The positive sign of *Credit* suggests that the more valuable a junior scientist proved to be towards one or more full professors (POs) from his/her discipline, the more chances she has of being promoted, after controlling for productivity (in any case *Credit* and *Productivity* are not correlated, as shown in Table 3b in Appendix A). It is important to stress that this holds true irrespective of the POs' productivity, which enter the denominator of *Credit* (indeed, having

[31] All other regressors besides gender and productivity are set at average values.

[32] Official data available for 2006 suggest the second reason prevailing: only the 15.8% of candidates for professor positions are females, while female MFCs in our sample account for 26.3% (see: DPE A6-A10, ANTARES, campagne qualification 2006 – http://media.education.gouv.fr/file/statistiques/25/8/qualif2006_36258.pdf, last visited: 11/12/2011).

[33] We can exclude that this result depends on CNR-connected Italian RUs choosing to move to CNR, instead of progressing to a professorial position in universities In fact, CNR has offered scant promotion opportunities to its own scientists for at least 20 years now, and almost no opportunities at all for outsiders.

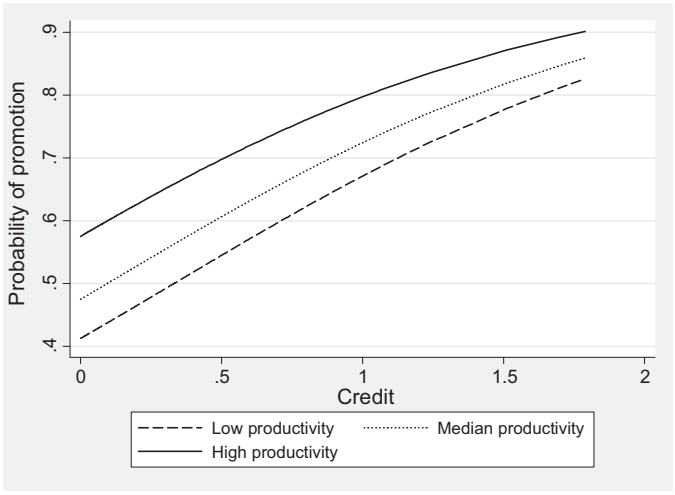

Fig. 3. Promotion probability from RU to PA as function of *Credit*. Italy. Marginal effects calculated on the basis of regressions (8) in Table 4. All other regressors besides gender and productivity are set at avg. values; productivities are calculated at the following percentiles: 25th (LOW), 50th (MEDIUM) and 75th (HIGH).

contributed to the few publications of a relative unproductive PO generates more credit than having contributed to the activity of a very productive PO).

Italian perspective candidates' promotion chances increase with *Credit*, reaching a maximum of 90% for a value of Credit near 1.78, on the basis of specification (4). Fig. 3 examines the probability of promotion for three Italian scientists with different productivity levels (respectively at the 25th, 50th, and 75th percentiles), as a function of *Credit* on the basis of specification (8) of Table 4. It suggests that an Italian scientist with low productivity, but *Credit* = 0.6 has roughly the same promotion probability as a highly productive scientist with zero *Credit*.

Fig. 4 reports the promotion probabilities of the same three scientists as a function of *Uni_connection*, according to specification (8). A potential candidate with low productivity has more chances of being promoted than a potential candidate with median productivity as long as the former has a *Uni_connection* value of around 50% (half his/her productivity shared with full professors of physics from his/her own university) and the latter does not usually publish

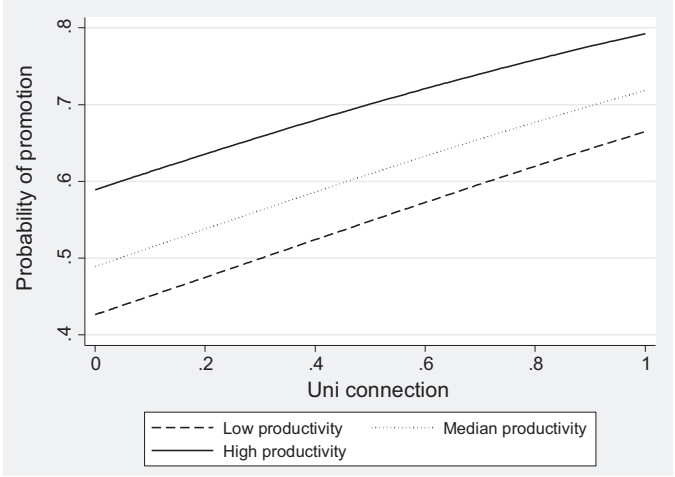

Fig. 4. Promotion probability from RU to PA as function of *Uni connection*. Italy. Marginal effects calculated on the basis of regressions (8) in Table 4. All other regressors besides gender and productivity are set at avg. values; productivities are calculated at the following percentiles: 25th (LOW), 50th (MEDIUM) and 75th (HIGH).

Table 5
Logistic model for promotion from PA to PO (Italy); individual, S&T human capital and political capital determinants.

	(1) Italy	(2) Italy	(3) Italy	(4) Italy
Gender	−0.39	−0.46	−0.43	−0.46
	(0.30)	(0.31)	(0.31)	(0.31)
Age	1.85***	1.82***	1.88***	1.83***
	(0.27)	(0.27)	(0.27)	(0.27)
Age^2	−0.02***	−0.02***	−0.02***	−0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Productivity	0.005***	0.004**	0.004***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
Field == F01	0.52	0.40	0.57*	0.45
	(0.33)	(0.34)	(0.34)	(0.34)
Field == F03	0.94**	0.85**	0.89**	0.84**
	(0.37)	(0.37)	(0.38)	(0.38)
CNR	−1.04	−1.29*	−1.43**	−1.52**
	(0.64)	(0.67)	(0.68)	(0.69)
INFM	0.16	0.28	−0.43	−0.024
	(1.39)	(1.39)	(1.48)	(1.45)
Collaboration with STARS		0.38*	0.38	0.37
		(0.23)	(0.23)	(0.23)
US collaborations	−1.63	−1.13	−0.88	−0.82
	(2.16)	(2.19)	(2.12)	(2.16)
Credit		0.56**		0.41*
		(0.22)		(0.23)
Uni_connection			1.18***	0.92**
			(0.44)	(0.46)
Constant	−45.0***	−44.6***	−45.8***	−44.9***
	(6.63)	(6.68)	(6.73)	(6.73)
McFadden's R2	0.186	0.199	0.200	0.205
Observations	578	578	578	578

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

with full professor of the same university (*Uni_connection* around zero).

The impact of *Uni_connection* may differ according to the size and the prestige of the university. The interaction term *Uni_connection* × *Top universities*, in columns 9 and 10, test this hypothesis, with *Top universities* indicating whether the perspective candidate is affiliated to one of the four more prestigious institutions in the country (according to the ARWU, 2009). In case of a positive value of the interaction term, the interpretation of the positive and significant effect of *Uni_connection* as a sign of localism could be doubtful, since we could be facing a mere statistical artefact.[34] And even if we were confronting a genuine preference for local candidates, it could be due to top universities' preference for their own candidates to professorial positions, which they may expect to be more productive than those coming for second-tier institutions. However, this is not the case, as the sign for *Uni_connection* × *Top universities* in column (10) is negative, which suggests that our results are actually driven by less prestigious universities and represent a genuine instance of localism, as presented in Section 3.

The role of political capital in Italy is also confirmed by additional regressions for Model 2, in which we consider promotions from the rank of associate professor (PA) to the top rank of full professor (PO), a career advancement that has no equivalent in the French system. From Table 5 we notice that the estimated coefficients for all relevant variables bear the same sign and significance of those for Model 1 (promotion from RU to PA). Estimates of the

[34] This is because more prestigious universities host more scientists (and more productive ones) than those in less prestigious ones. It follows that perspective candidates in the former simply have more chances to find senior co-authors within their home institution.

marginal effect of age indicates that the positive effect of seniority on promotion persists until the age of 50, which suggests that additional seniority is more valuable for higher ranks. That is, PAs who are over 40 and seeking promotion to PO stand better chances than RUs of the same age seeking promotion to PA. We consider all these results as a sign of robustness of our main analysis.

5.3. Discussion

Our analysis confirms the importance of seniority and scientific productivity for academic careers, as found repeatedly in the literature. Controlling for scientific productivity, the older a French MCF or an Italian RU, the higher his/her chances of promotion to a professorial position, but only up to an age between 40 and 45 (50 for promotion from PA to PO in Italy). After then, promotion chances decline. As for productivity, our estimates suggest the existence of positive but diminishing returns, with a stronger effect for Italy.

We find a different impact of *gender* on career in the two countries, negative in France and non-significant in Italy. We observe that the French system, however, host many more women than the Italian one. Accordingly, we interpret our results as follows: while Italy exhibits its gender effect at the entry level (by depressing the number of women who manage to enter the academic system at the bottom rank), France is less gender-biased at the entry level, but more so when it comes to access to professorial ranks.

S&T-HU capital, as measured by ties to large PROs, matters positively in France, but negatively or not significantly in Italy. We interpret this result as a sign of the institutional difference between the two countries, with France still granting a great importance to CNRS, while Italy is progressively emptying CNR of its influence, as discussed in the literature.

As for measures of S&T-HU capital based on collaboration with star scientists or US scientists, these appear not to be significant in either country. One interpretation of this result points at the age of MCFs and RUs considered for promotion, who are all in their mid-thirties or older. When compared to the very young PhD graduates usually examined by the dominant US literature, therefore, our potential candidates are relatively senior, have already a position in their university, and a publication record. The latter may thus provide all the information needed by the examination committees, who need to look no further into the potential candidates' S&T-HU capital.

Important differences between the two countries emerge when considering political capital. In Italy, where disciplines are narrow, and committees for local recruitment are controlled by *professori ordinari* at the national level, we find that a potential candidate's promotion chances are positively affected by the *Credit* she can collect from one or several POs. On the contrary in France, *Credit* does not appear to be significant. This suggests that connections at the national level may not matter much in France, as decisions at the local level are the key ones.

However, when it comes to such local level, our measure of political capital turns out to be significant for Italy (as expected), but not for France. This difference is unexpected, as the *commissions de spécialistes* (now replaced by different organisms, but still in place in the years we considered) were local, could include representative of similar disciplines, and stood for several years. We notice however that the literature, while denouncing a high degree of localism for French universities as a whole, also suggests that some disciplines are less affected by it than others (mathematics being often cited as an example of non-localism). And indeed our descriptive statistics suggest that, in physics, localism in France appears to be lower than in Italy, with 20% of professorial positions granted to non-local scientists. Therefore, we should investigate other disciplines to check whether our results indicate that the issue of localism has been over-emphasized by the literature, or that it simply not an issue in the specific case of physics.

6. Conclusions

In this paper we have examined the determinants of academic careers in two European countries, Italy and France, whose university and research systems are very different from the US one, to which most of the available literature refers. We have studied the case of physics, and assembled data on academic scientists' productivity, affiliation, and careers in between 2000 and 2003 (France) or 2000 and 2005 (Italy). We have considered both individual and social determinants of moves to professorial positions for French *maîtres des conferences* and Italian *ricercatori*.

As for individual determinants (productivity, gender, and seniority), our results are in line with the US-based evidence, although some differences were found between the two countries considered. Coming to social determinants, we have distinguished between social capital that contribute to enhance an individual scientific potential (scientific and technical human capital) and political capital directly bearing an influence on decisions over promotion. In both cases, we have produced bibliometric indicators that try to capture the specificities of the two countries considered.

As for scientific and technical human capital, we found that connections to public research organizations (PROs) help academic careers in France, but not in Italy. We take it as a sign of the different influence that PROs exert on universities in the two countries.

At the same time, we found that our measures of political capital matter in Italy, but not in France. In particular, Italian potential candidates to professorial positions benefit from intensity of collaboration with full professors (*professori ordinari*) in their own (narrowly-defined) discipline, who bear direct influence on their selection committees; and also from local collaboration, again with full professors, in more broadly defined disciplines.

At a theoretical level, our findings on social capital suggest that it is advisable to analyze networks of scientists not only in terms of knowledge diffusion (as typical of recent literature in the economics of science, and its main analysis of the structure of co-authorship networks), but also in terms of power and rewards for political exchanges.

A better understanding of individual scientists' career incentives and constraints, of the type we tried to provide with our study, may help to evaluate recent reforms in the two countries, which touch upon many aspects of academic life, including recruitment. Both reforms nominally address the problem of university administrations' weaknesses with respect to the professoriate, but never mention nor address the issue of disciplines; nor they seem to "learn the lesson" from experiments already failed in other countries.

In France, the key novelty introduced be the 2007 reform (see footnote 15) has consisted in replacing the *commissions de spécialistes* with the *comités de sélection*, with analogous tasks, but fewer links to the local professoriate (Schwartz, 2008). Committee members are now nominated by the non-academic members of the university's board of directors, stay in place only for one *concours*, and can see their choice of candidates vetoed by the university president (following a request by non-academic members of the university's board of directors). Some incentives have been also put in place that go in the direction of recruiting more external candidates. Still, the system has not changed its fundamentals, with all the academic staff classified by state-sanctioned disciplines, a discipline-based national level of habilitation, and an abundance of top-bottom rules and regulations. And the Italian experience shows (also in our analysis) that having committees in place for just one recruitment decision does not diminish localism.

As for Italy, a recently approved, but not yet implemented reform has basically introduced many items typical of the French system, without much consideration for the critiques directed at the latter, and with some paradoxical extras.[35] Italian professors will now be recruited following a French-like two-step procedure (habilitation plus local *concorso*), with local committees composed only of full professors (the same who exercised tight control so far, as shown by our *Credit* measure), to be in part elected and in part chosen by lot (a practice already experimented and discarded in France several years ago). State-sanctioned disciplinary control over recruitment still will be norm, and possibly strengthened. Besides, while France has coupled the introduction of its reform alongside to a major injection of funds in the academic system, Italy has done the opposite. For example, several budgetary restrictions for replacing retired academic staff with new recruits have been put in place, which will further worsen the current age composition problems. An Agency for the Evaluation of Research and Universities has been put in place, but still no separate sources of funding have been introduced for ordinary expenses (including wages) and research budgets; so it is not clear to anybody what consequences the evaluation exercise will have for universities, and how this should affect recruitment choices.

Evaluating the effects of these reforms on academic careers in France and Italy will be the task of future research. Improved measures of political capital will be necessary, especially for disciplines that, differently from physics, do not lend themselves so easily to bibliometric analysis. More precise information on dates of recruitment will be also necessary. In any case, we believe that coupling the general investigation of major themes in the economics of science with country-level specification of career system is the way forward for informing the policy debate on current changes in the European academic system.

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Appendix A.

Table A1
Rank and age distribution of physicists (in selected disciplines) on active duty in 2000.

	Number (and % of total physicists) – (1)	Age in 2005 (2)	Age of nomination (avg) (3)	Promoted to present rank after 2000 [% of (1)] (4)
France				
MCFU	1397(65%)	43.96	33	0.21
PR	758(35%)	54.33	42	0.22
Italy				
RU	524(30%)	43.55	34	0.40
PA	640(36%)	53.29	41	0.38
PO	606(34%)	60.57	47	0.33

Table A2
Fields and probability of being promoted (MCFU, RU, PA); year of reference 2000.

	Number (% of total physicists)	% of promoted after 2000
France: MCFU		
Milieux denses et matériaux	559 (69)	13.05
Milieux dilués et optique	254 (31)	14.17
Italy: RU		
Fisica sperimentale	245 (52)	44.08
Fisica teorica, modelli e metodi matematici	80 (17)	32.50
Fisica della materia	144 (31)	53.47
Italy: PA		
Fisica sperimentale	369 (64)	29.53
Fisica teorica, modelli e metodi matematici	100 (17)	25.00
Fisica della materia	109 (19)	45.87

NB for MCFU and RU only age between 30 and 50 is considered.

[35] The reform was approved a few days before the end of 2011, and yet no major regulation based on it has been issued. As a consequence, the available literature is sparse and not yet of scientific quality. See however, in English: Paterlini (2009), Degli Esposti and Geraci (2010), Nature (2010); and various comments, in Italian, in a dedicated section of the website of Gruppo 2003, an association of self-styled "[Italian] world's most cited scientists in scientific literature" for the promotion of scientific culture (http://www.scienzainrete.it/topic/771). Also online and also in Italian, see the section "Scuola e Università" of: http://www.lavoce.info/.

Table A3a
Correlation matrix, for French MCFs.

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
[1]	Promotion	1										
[2]	Gender	−0.11	1									
		[0.00]										
[3]	Age	0.13	−0.03	1								
		[0.00]	[0.35]									
[4]	Age^2	0.12	−0.03	1	1							
		[0.00]	[0.34]	[0.00]								
[5]	Productivity	0.18	−0.09	0.08	0.08	1						
		[0.00]	[0.01]	[0.02]	[0.03]							
[6]	Field == F30	0.02	−0.06	−0.08	−0.08	0.07	1					
		[0.67]	[0.09]	[0.02]	[0.02]	[0.04]						
[7]	CNRS	0.06	−0.13	−0.1	−0.1	−0.01	0.09	1				
		[0.06]	[0.00]	[0.00]	[0.00]	[0.79]	[0.01]					
[8]	Collaboration with STARS	0.07	−0.11	0.01	0	0.21	0.08	0.11	1			
		[0.05]	[0.00]	[0.83]	[0.91]	[0.00]	[0.03]	[0.00]				
[9]	US collaborations	−0.01	0.05	−0.07	−0.06	0.14	0.06	−0.1	0.07	1		
		[0.67]	[0.20]	[0.06]	[0.07]	[0.00]	[0.07]	[0.00]	[0.05]			
[10]	Credit	0.1	−0.17	0.02	0.01	0.19	0.03	0.09	0.33	−0.01	1	
		[0.00]	[0.00]	[0.55]	[0.71]	[0.00]	[0.33]	[0.01]	[0.00]	[0.86]		
[11]	Uni_connection	0	−0.11	−0.06	−0.06	−0.02	0.02	0.08	0.28	0.02	0.5	1
		[0.95]	[0.00]	[0.07]	[0.08]	[0.65]	[0.57]	[0.03]	[0.00]	[0.64]	[0.00]	

p values in square brackets.

Table A3b
Correlation matrix, for Italian RUs.

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
[1]	Promotion	1												
[2]	Gender	−0.08	1											
		[0.08]												
[3]	Age	0.02	0.1	1										
		[0.66]	[0.03]											
[4]	Age^2	0	0.11	1	1									
		[0.93]	[0.02]	[0.00]										
[5]	Productivity	0.19	−0.21	−0.05	−0.05	1								
		[0.00]	[0.00]	[0.30]	[0.24]									
[6]	Field == F01	−0.02	0.03	−0.1	−0.1	−0.4	1							
		[0.68]	[0.55]	[0.03]	[0.03]	[0.00]								
[7]	Field == F03	0.11	0.05	0.07	0.07	0.12	−0.7	1						
		[0.01]	[0.33]	[0.15]	[0.16]	[0.01]	[0.00]							
[8]	CNR	−0.12	−0.11	0.08	0.08	0.08	0.06	−0.37	1					
		[0.01]	[0.01]	[0.08]	[0.07]	[0.07]	[0.19]	[0.00]						
[9]	INFM	0.1	−0.03	−0.2	−0.2	−0.02	−0.07	0.21	−0.26	1				
		[0.04]	[0.54]	[0.00]	[0.00]	[0.70]	[0.15]	[0.00]	[0.00]					
[10]	Collaboration with STARS	0.14	−0.1	−0.01	−0.01	0.41	−0.27	0.11	0	0.09	1			
		[0.00]	[0.04]	[0.85]	[0.77]	[0.00]	[0.00]	[0.02]	[0.95]	[0.05]				
[11]	US collaborations	−0.02	0.02	−0.06	−0.06	0.14	0.05	−0.04	−0.1	−0.14	−0.04	1		
		[0.68]	[0.71]	[0.20]	[0.17]	[0.00]	[0.27]	[0.33]	[0.04]	[0.00]	[0.42]			
[12]	Credit	0.17	0.02	0.02	0.02	−0.04	0.2	−0.07	0.1	0.03	0.01	0.02	1	
		[0.00]	[0.61]	[0.74]	[0.73]	[0.41]	[0.00]	[0.15]	[0.04]	[0.50]	[0.82]	[0.65]		
[13]	Uni_connection	0.15	0.02	−0.13	−0.13	−0.07	−0.06	0.14	−0.04	0.24	0.21	−0.12	0.35	1
		[0.00]	[0.62]	[0.01]	[0.01]	[0.11]	[0.19]	[0.00]	[0.35]	[0.00]	[0.00]	[0.01]	[0.00]	

p values in square brackets.

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