Incentives, Sorting and Productivity along the Career: Evidence from a Sample of Top Economists[1]

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Abstract

In this paper we study empirically the labor market of economists. We look at the mobility and promotion patterns of a sample of 1,000 top economists over thirty years and link it to their productivity and other personal characteristics. We find that the probability of promotion and of upward mobility is positively related to past production. However, the sensitivity of promotion and mobility to production diminishes with experience, indicating the presence of a learning process. We also find evidence that economists respond to incentives. They tend to exert more effort at the beginning of their career when dynamic incentives are important. This finding is robust to the introduction of tenure, which has an additional negative ex post impact on production. Our results indicate therefore that both promotions and tenure have an effect on the provision of incentives. Finally, we detect evidence of a sorting process, as the more productive individuals are allocated to the best ranked universities. We provide a very simple theoretical explanation of these results based on Holmström (1982) with heterogeneous firms.

1 Introduction

Contract theory has proposed various solutions to reconcile a principal and an agent who have conflicting objectives and to provide the agent incentives to exert effort. The standard answer has been to pay the agent according to his production in a static contracting context (see e.g. Holmstrom, 1979). However, a small area of this literature has emphasized the importance of dynamic interactions between an individual and the market. Repeated interactions facilitates learning about the agent's talent by observing noisy signals (Jovanovic, 1979) and can also provide a solution to the moral hazard problem (Fama, 1980; Holmstrom, 1982).

There has been growing interest recently in the theory and evidence of dynamic incentives and careers in organizations. Unlike static incentives, which are explicitly stated in a contract, dynamic incentives are often implicit: they reflect the concerns of economic agents for their career, as revealing their talent to the market will allow them to extract higher rents in the next periods.

The first paper to introduce career concerns - also called implicit incentives - is Fama (1980). Departing from the classical static models of the contracting literature, he considers a dynamic setting explaining how the managerial labor market - both within and outside the firm - disciplines the behavior of a manager in term of incentives. For the market, present performance acts as a signal about the talent of the agent and thus about future performance. Because managers are concerned about their reputation, they will be induced to exert effort. Holmström (1982) formalizes this intuitive idea. In his model, a competitive labor market assesses the unknown talent of an agent via his performance, which is also a function of his effort and a stochastic noise. In the beginning of each period, the agent is paid his

expected productivity, partly determined by the market belief about his talent. The market updates its belief every period and, as time elapses, gives less weight to new information. As a consequence, the agent exerts effort to influence the assessment of the market about his talent, but as the returns to effort decrease with experience, incentives also become weaker with time and therefore effort declines with experience[1]. Gibbons and Murphy (1992) propose an extension that allows for explicit incentives. They show that implicit and explicit incentives are substitutes: wages should be more related to performance when dynamic incentives are weak. Tournament theory (Lazear and Rosen, 1981) considered in a dynamic context generates similar results (Rosen, 1986; Lazear, 2003) but models hierarchies and promotions explicitely. Promotions generate incentives ex ante but these diminish after the promotion. One way to keep effort high is to increase the wage gap along the hierarchy.

Because of the assumptions that talent is equally valued in all firms and that the market is competitive, the career concerns and tournament theory literature do not consider inter-firm mobility explicitly. Jovanovic (1979) stresses the importance of learning to explain job mobility. In his model, an agent is endowed with some unknown characteristic: the match existing between him and the firm he belongs to. This contrasts with previous models where the unknown variable was only specific to the individual. There is a learning process about the match via the observation of individual performances, which are function of the match and a noise. In this model, there

[1] Another effect is that young managers may be tempted - if they are risk averse - to engage in herding behavior so as to avoid to give a wrong signal about their talent to the market in the beginning of their career (Scharfstein and Stein, 1990). This herding behavior due to career concerns has been a major concern of papers investigating empirically implicit incentives.

are no concerns about effort and moral hazard problems. The agent is paid his expected productivity. The major difference between this model and the ones described above is that the agent will respond to the signalling in term of turnover: he will keep the same job until he thinks that he can find a better match somewhere else. Time also plays a role in Jovanovic's model: the probability of separation, due to the learning process, decreases with experience.

Learning and manipulation of beliefs are likely to be widespread across all classes of economic activities where skills are highly valuable and segmentation by skills is present. Yet, to date, empirical studies have been scarce and focused on financial activities using data from CEOs, fund managers and security analysts. Gibbons and Murphy (1992) analyze wage dynamics, using a sample of around 3000 CEOs over the period 1971-1989 and they find that wages are more sensitive to performance as individuals come closer to retirement. This is consistent with the idea that static incentives should be more important when dynamic incentives become weaker. Chevalier and Ellison (1999) look at the relationship between termination and performance using a sample of 453 mutual fund managers during the years 1992-1994. They find that a manager's probability of being terminated is negatively related to performance and that termination is more performance sensitive for young managers. Moreover they show that young managers might have an incentive to herd, as they are more likely to be terminated if unsystematic risk deviates from the mean of the fund's objective group. Hong et al. (2000) analyze the relationship between career concerns and herding using data of 8421 security analysts between 1983 and 1996. They also find that termination is more performance related for less experienced analysts, and that young analysts herd more than their older counterparts. Hong and Kubik (2003) extend the analysis and look at upward and downward mobility.

They find that more (less) accurate analysts are more likely to experience a move to a more (less) prestigious firm.

We extend the literature by analyzing career concerns in the academic profession. Learning about individual ability through publication should play an important role in explaining promotion patterns within departments. Moreover, we do not only focus on mobility along the hierarchy of the firm, but we also look at mobility across firms, as our database allows us to track people even when they leave the firm.

Another recent strand of the literature has analyzed individual career paths in a firm's internal labor market where workers are shielded from the outside At first mostly descriptive, this new literature has developed theories integrating various building blocks models to better understand the complex reality observed in firms. Empirical work so far has been limited to a small amount of studies describing the internal labor market of a single firm.

This branch of the literature has first been mainly empirical and descriptive and has focused on issues very close to the ones that we analyze here. The pioneer work can be found in Doeringer and Piore (1971), their central idea being that the internal organization of the firm is shielded from outside. The main consequences are that the hierarchy remains stable over time and workers follow well-established career paths; wages are more attached to jobs than individuals; and firms restrict movements between the inside and the outside labor market to a limited number of jobs [there exist ports of entry and exit in the job structure]. This topic has been left aside by economists for more than twenty years and raised again only recently by Lazear (1992) and Baker, Gibbs and Holmström (1994a,b). Both studies look at the internal structure of one single firm by analyzing the wage structure and the career path of the workers inside the firm. While they confirm the pres-

ence of a stable hierarchy over a long period of time, and the existence of careers inside the firm, they do not find much evidence of ports of entry and exit, and mixed evidence that wages are attached to jobs, suggesting the existence of a learning process about ability. This is further confirmed by the finding that wages and promotions are serially correlated, the latest being evidence of systematic fast tracks. This set of new facts have given rise to new models of internal labor markets. Gibbons and Waldman (1999a) explain a large amount of these facts by integrating various building-block models: job assignment, on-the-job human capital acquisition and learning.

In the academic labor market, job assignment is a less crucial element than in firms, as individuals do the same job in all ranks. On the other hand, learning and human capital acquisition are likely to be as important. We add in dynamic incentives as an additional building block in our empirical analysis, as suggested by Gibbons and Waldman (1999b).

Our database allows us not only to look at the careers of individuals inside firms but also at careers between firms. While we do not have information on individual wages (we only have average wage by rank) and our sample does not contain the entire population of a given firm, our approach is very complementary.

We also contribute to the small literature studying the effect of research productivity on mobility in the academic labor market (Ault et al., 1979, 1982; Long, 1978; Allison and Long, 1987). These studies typically find no or a small effect of productivity on upward mobility, and document instead a pedigree effect on promotion and a departmental effect on productivity. However, these studies consider only individuals who change university, and therefore do not treat the mobility decision as endogenous. Moreover, they do not consider promotions explicitly. We use a large sample of top economists and analyze the relationship between performance and both uni-

versity change and promotion, explicitly linking our results to the theories of learning and human capital acquisition.

Most studies interested in testing the effect of performance on pay or career evolution are confronted with the - often impossible - task of finding individual productivity data, and to relate this variable with the personal characteristics and career path of the agents (see e.g. Lazear, 2000). The advantage of taking top economists as an object of study is that these data are relatively easy to obtain. Economists usually post their CVs on their personal website, so that one can easily extract personal information such as the year of promotion to professor or the university where one graduated. Information about research productivity is available through bibliographic databases such as Econlit. Moreover, jobs along the hierarchy are easily identifiable and standard across "firms".

We link promotion and mobility patterns of economists to their productivity and evaluate how the sensitivity of promotion and mobility to productivity evolves with experience and with academic positions. We also analyze the dynamics of individual productivity along the career, testing whether faculty exert less effort after being promoted. In addition of looking at incentives, we also try to determine if mobility leads to sorting of individuals across universities.

We find that the probability of promotion is positively related to past production but also that the sensitivity of promotion to production diminishes with experience. We get a similar finding for upward mobility: the change in quality of the institution when an economist switches university is dependent on his production and production becomes less and less important for mobility as the individual becomes more experienced. We find that economists respond to dynamic incentives: effort is higher at the beginning of the career, when dynamic incentives are strong. This finding is robust to

the introduction of tenure, which has an additional negative ex post impact on production. Our results indicate therefore that both promotions and tenure have an effect on the provision of incentives. We also detect the presence of a sorting process as the more productive individuals are allocated to the more productive universities. To link our empirical results to theory, we build a very simple model that generates incentives and sorting based on Holmström (1982) career concerns model with heterogeneous firms.

Our analysis has two important limitations. First, we are not able to consider the various job dimensions of economists in our dynamic analysis and concentrate instead on research. Our emphasis on research is probably less problematic within our sample as the top economists are likely to be employed in institutions that consider research as the most important task. These other tasks are more difficult to measure. To try to correct for this weakness, we examine how teaching differs according to the rank and the research quality of the university for a cross-section of individuals. We find that teaching is slightly lower in the higher ranks and in the best universities but these differences are small, suggesting that teaching is distributed relatively homogenously. Unfortunately, we are not able to control for the other tasks such as administrative or editorial duties. Second, we have no information about individual wages, which would have provided further evidence about the learning process, but also would have improved the understanding of promotions and mobility, as we would have been able to observe the wage differences associated with internal and external mobility. However, existing evidence shows that average wages increase along the hierarchy and with the quality of the university (see e.g. our companion paper, Coupé et al., 2003) so that on average, promotions and upward mobility are likely to be associated with a wage premium.

The rest of the paper is organized as follows. Section II describes our dataset and provides summary statistics. In section III, we analyze the promotion decision. In Section IV, we turn to the mobility issue. In Section V, we look at the dynamics of productivity along the career and examine whether individuals respond to dynamic incentives. Section VI analyzes more particularly the effect of the tenure sytem. Section VII presents a theoretical explanation of our results and concludes.

2 Data

Our dataset consists of a combination of various sources. The first one is the bibliographical database EconLit. EconLit keeps record of all publications from 1969 onwards in the most important journals of the profession[2]. The publication is linked to each author, who is linked (since 1990) to the university to which he is affiliated at the time when the paper was accepted. We extracted the entire information contained in the 2000 version of EconLit and aggregated publications by year and by individual. One interesting and very important feature of this dataset is that we are able to follow the individual productivity of economists and of universities on a year-by-year basis, that we will use as measure of individual **performance** in terms of research.

The dataset can also be used to create a worldwide ranking of individuals over a given period. All rankings are typically criticized on the subset of journals that they consider and how a publication is weighted depending on the quality of the journal where it was published. There is a large dose of subjectivity associated with these choices. To deal with this criticism, we

[2]In the period 1969-2000, some 800 journals have been indexed by Econlit. About 10% of these have been included every year since 1969. For information on which journals were included when, see http://student.ulb.ac.be/~tcoupe/update/journals.html

have selected 12 different weighting techniques which have been widely used in the literature, and we have used the average of the rankings based on these 12 different measures to determine an average ranking of individuals (see Coupé, 2000). We also follow the literature by correcting the weight of a publication for co-authorship, dividing the weight of the paper by the number of authors. Using this technique, we identified the 1000 top economists for the period 1987-1998.

As a second step, we collected information about the career of these 1000 top economists by downloading their vitae from their personal websites[3]. We kept only those individuals for whom we could clearly identify the entire career since the year of PhD. This was the case for **652 individuals**. Economists post their vitae homogenously and we were able to find the year of PhD, the university of PhD, the rank, the employer and the year of promotion. However, very few economists indicated the year when tenure was awarded, despite the importance of this information, especially in the North American market. Moreover, research represents only one of the tasks for which economists have to exert effort, the others being teaching, administrative duties and possibly consulting.

Therefore, in March and April 2003, we sent a survey by email to ask about the year of tenure, but also about the number of teaching hours in the first and second term of the academic year 2002-2003[4]. These questions were only relevant for individuals having an academic position. The answers regarding the year of tenure can be used in our dynamic econometric analysis.

[3] In addition, we used the AEA survey of members (http://www.eco.utexas.edu/aea/), the information on the NBER website (http://nber.org/vitae.html) and finally the Who's Who in Economics (Blaug, 1999).

[4] We also ask questions about the amount of consulting but due to the lack of homogeneity in the way the answers were reported, we were unable to use them. Administration or editorial work is another dimension that we are not able to control for.

This is not the case for the teaching information. We received 415 answers, implying an answer rate of more than 60%, a very satisfactory figure.

Finally, the career information from the web search and the survey were matched to the publication information from EconLit.

Sample description Most of the economists in our sample work in the US: in 1998, 530 out of 650 (two had died before the end of the period) were affiliated to an institution in the US, 76 in Europe, 22 in Canada, 11 in Asia, 8 in Israel, 2 in South America and 1 in Australia. There are only 33 women.

By definition, our sample is not representative of the whole population of economists. Why did we decide to focus on the top economists in a first stage? First of all, it was easier to find information about these individuals. Second, we asserted that top researchers were likely to have interesting mobility patterns. In any case, we do not try to generalize our results to the economic profession.

Our sample also differs from the internal labor market literature as we do not focus on one single firm, but rather compare career paths of individuals in a labor market where talent can be argued to be hardly firm specific and where firms value the same skills. There are pros and cons of this approach. A big advantage is that we follow individuals when they leave the firm, and that we know the past employment history of the individual, even outside the firm. A disadvantage is that we only have a limited sample of individuals, as opposed to the entire population of a firm[5].

[5]In a companion paper (Coupé et al., 2003), we use information of a cross-section of the entire population of individuals working in the 107 economic departments ranked by the NRC in 1995 to test which theory is the best suited to explain the wage structure along the hierarchy. We are not able to use the wage data in the present paper because they are aggregated by rank and thus not suited for a study of individual careers.

The appendix provides the summary statistics about the dependent and independent variables used in our analysis. Experience is defined as the number of years since an individual obtained his PhD. The mean level of experience is 11.6 years. However, there is a considerable amount of heterogeneity in our sample: in 1998, three individuals had more than 50 years of experience and are still considered in our sample, while five have only 5 years of experience and are already considered in our sample (see table 1). Table 2 shows that around 65% of our sampled individuals obtained their Ph.D. from a subset of only ten universities, the MIT accounting for 15% of the Ph.D.'s awarded.

Current and past research productivity To control for the quality of the publications, various schemes have been proposed in the literature[6]. We indicated already that we selected 12 different methods to select our individuals. However, in our econometric analysis, we use only a subset of these measures. The more objective and also most frequently used way to judge the quality of a publication is based on the expected citations of a paper published in a given journal. The first measure is the number of publications weighted by the impact factor of the journal. The impact factor is equal to the citations in year t to the articles published in journal J in $t-1$ and $t-2$ divided by the number of articles published in J in $t-1$ and $t-2$. This reflects the number of citations that can be expected for an article published in J, measured one to two years after publication. This impact factor is available for 273 journals and made available on CD Rom.

However, this method has been criticized based on the fact that many

[6] We decided not to use citations as an additional variable because we could not identify the number of citations per year but only the stock of citations at the end of the period, i.e. between the year of publication and 1998.

non economic journals are present in the database and that the hierarchy based on reputation is not respected[7]. Therefore, we also use the adjusted impact methodology proposed by Laband and Piette (1994). Their index is based on 4 years of data (1990 citations to articles published between 1985 and 1989) and considers only economic journals in a stricter sense. The disadvantage is that this adjusted index is only available for 121 journals[8]. We divide the Laband and Piette (LP) adjusted index by 100 for ease of interpretation. Our results are robust to the different weighting schemes used.

On average, economists in our sample publish the equivalent of 0.4 article by year in the Quarterly Journal of Economics (QJE) according to the impact factor weight (0.8 according to the LP corrected impact factor weight). However, the most prolific scholars were able to publish the equivalent of 7 papers in the QJE (Samuelson in 1974 and Feldstein in 1976) in a given year.

In our econometric analysis, we want to assess whether research productivity affects internal and external mobility and find evidence of learning, and so we need a measure of past productivity. We use two different measures of performance in $t-1$: a short run past performance and a long run past performance. The first one is the the sum of weighted past publications for a period of three years, from year $t-3$ to $t-1$. The second is the past cumulative history of the individual, i.e. the sum of weighted publications from 1969 to $t-1$.

However, it is not clear whether it is important to lag our productivity measures because of the well recognized publication lag that changes the

[7] This is less likely for our subset of economists since they were selected as the most productive based on 12 different weighting schemes.

[8] For a list of journals and weights see http://homepages.ulb.ac. be/~tcoupe

timing of observing research productivity. While the market is likely to evaluate individuals on the basis of their CVs, forthcoming publications are also taken into account for promotions and job offers. Therefore, we adapt our two measures to control for publication lags. Our short run past performance variable controlling for publication gap is the the sum of weighted past publications from year $t-1$ to $t+1$ and the long run past performance variable controlling for publication gap is the sum of weighted publications from 1969 to $t+1$.

Job categories and promotions: According to the information provided on the CV, we define 5 different job categories, 4 of them being related to the academic world. Based on the US system, assistant professor is noted as 1, associate professor as 2, professor as 3 and endowed professors as 4. We applied an equivalence rule for the non-US institutions, although most non-US economists tended to indicate the US equivalent on their CV. Category 5 includes individuals working outside the university sector (central banks, private firms and international institutions). This is another specificity of our dataset and of the academic profession: jobs are easily defined and standardized across universities.

We define a promotion as a upward switch within the university system (from category 1 to 4). We observe 1,156 promotions over the period. The most frequent types of promotions are hierarchical: 465 are promotions from assistant to associate professor, 406 from associate to full professor and 196 from professor to endowed professor. It is not very clear whether we should consider the latter type of promotion in our analysis because not all universities have endowed chairs. We also find the same results if we do not allow a switch from professor to endowed professor as a promotion, and our results do not depend on it. Therefore, we stick with our classification.

Individuals differ with respect to the number of years that they spend in a given position before being promoted. For all the individuals who were promoted to associate professor, the number of years as assistant professor varies between 1 and 12 years, with a mean of 4.72. For all individuals who were promoted to professor, the average number of years spent as associate professor is 4.05 and varies from 1 to 14.

Tenure Promotions constitute an important component of dynamic incentives provided in universities, as they are accompanied typically by wage and status increase. When put in practice (standard procedure in North America, rare in Europe), the tenure decision provides further incentives to work hard. Tenure implies almost complete job security but is a relatively difficult hurdle to beat, generating the well known up-or-out decision by the principal.

Out of 415 answers, 16 economists were out of academe and 8 had tenure before getting their PhD (7 of them in Europe, 1 in Asia). Summary statistics are based on the 391 more standard answers. The average time before getting tenure is 5.86 years. However, there are large differences in our sample, even among economists in the same department.

Tenure is awarded at different stages of the career. In many universities, it goes automatically with the promotion from assistant to associate professor. Others take more time to select individuals and wait a few years after that. In general, the higher the quality of the university, the latter in the career comes the tenure decision.

Teaching Unfortunately, we are not able to use the information about teaching behavior in our econometric analysis, because it refers to the academic year 2002-2003, while our period of analysis goes until 1998. We

expected that the answer rate would be smaller if we asked retrospective questions about teaching. Nevertheless, we try to gain insight about teaching that we could link to our results.

41 individuals were on sabbatical during the first term of the academic year 2002-2003, and 44 during the second term. Allowing for overlapping, 53 were on sabbatical during at least one of the two terms. On average, individuals were teaching 2.95 hours during the first term and 3.23 during the second.

Most individuals who answered the survey have become professor (206) or endowed professor (174) in 2003, while 15 are still associate, 2 assistant and 2 emeritus. Therefore, we can get only get limited insight on the evolution of teaching along the career. Teaching tends to diminish along the career in the sample, going from 3.97 hours a week as associate to 3.16 as professor and 2.98 as endowed professor. Teaching also appears to be lower in the higher ranked universities. However, there are no large differences between countries.

University categories and research productivity The individuals are linked to their employer. The quality of university research is measured in different ways. For the period 1990-1998, we aggregate individual publications by university, and we follow the same strategy than for individuals to create a ranking of universities, i.e. considering the average of our 12 weighting schemes. The problem is that we would like to be able to assess the quality of university research before 1990. Therefore, we selected a sensible ranking that is compatible with previous rankings. For earlier periods, we use Niemi (1975) for the period 1970-1974, Graves et al. (1982) for the period 1974-1978, Hirsch et al. (1984) for the period 1978-1982, and Scott and Mitias (1996) for the period 1983-1994. These studies have the

advantage that they are comparable but relatively selective. These rankings consider the number of pages in the same 24 top journals[9], except the ranking by Scott and Mitias based on 36 journals (of which 21 similar to the other studies), for different time periods and are corrected for differences in page size. While the number of pages is unlikely to be related to the quality of the paper, the main advantage is that we are able to follow the dynamics of the rankings, or, in other words, to have a time-varying assessment of the quality of the departments.

One disadvantage is that these papers only ranked US universities, except Hirsch et al. (1984). This means that for the early periods before 1990, we are not able to identify very precisely upward or downward moves from one European university to another. This is a minor difficulty because of the high percentage of individuals working in the US, but we should keep it in mind for the interpretation and representativeness of the results. Another criticism against this ranking is that they are biased in favor of universities that have strong research oriented business schools, as it is difficult to distinguish between business school economists and economic departments economists. To properly address this concern, one would need the evolution of the composition of economic departments and to our knowledge, this

[9] 1) American Economic Review, 2) Econometrica, 3) Economica, 4) Economic Development and Cultural Change, 5) Economic Journal, 6) Industrial and Labor Relations Review, 7) International Economic Review, 8) Journal of Business, 9), Journal of Economic History, 10) Journal of Economic Theory, 11) Journal of Finance, 12) Journal of Human Resources, 13) Journal of Law and Economics, 14) Journal of Money, Credit and Banking, 15) Journal of Political Economy, 16) Journal of Regional Science, 17) Journal of the American Statistical Association, 18) National Tax Journal, 19) Oxford Economic Papers, 20) Quarterly Journal of Economics, 21) Review of Economics Studies, 22) Review of Economics and Statistics, 23) Southern Economic Journal, 24) Western Economic Journal.

information is not available[10]. Moreover, many top economists are often affiliated to both the business school and the economic departments.

Table 3 shows the evolution of rankings and university production over a relatively long period, from 1970 to 1998 for the top 20 departments. Some stylized facts emerge from the data: Chicago and Harvard have persistently remained at the top, while more dynamics is present among the followers. Production on a 5-year period appeared to have increased for the top departments. Following this pattern, we divide universities in seven different categories: the top 2 (category 7, Chicago and Harvard), the close contenders (category 6, those ranked between 3rd and 9th), the contenders (category 5, between the 10th and the 24th position), the upper middle ranked (category 4, those ranked between 25th ad 49th), the lower middle ranked (category 3, between the 50th and the 100th), the low ranked (category 2, between the 100th and 300th position) and the very low ranked (category 1, those under the 300th position).

Individual mobility While internal labor market considerations are an important aspect of the academic labor market, another contribution of the paper is that we also consider the external labor market, i.e. the mobility from one university to another. Mobility can be driven either by the individual looking for a better employment opportunity, or by the firm, which could consider that the individual is not a good "match" and therefore does not want to keep him.

University changes occur more rarely than promotions: the average university change rate is 6.7%. Table 4 provides the distribution of the number of university change by individuals along their career. Some move a lot: 19

[10] In Coupé et al. (2003), we were able to get information on a series of cross section for the population of 107 universities, but we had only limited dynamic information.

individuals move more than three times. The university change rate varies along the hierarchy: full professor in particular move much less than assistant and associates (table 5). This is an indication about the "up-or-out" nature of the academic labor market, and the fact that individuals become better matched with time.

Outside mobility can also described as going upward, downward or to a similar university. We define an upward move (UP) as a move to a university of a higher category, a downward move ($DOWN$) as a move to a university of a lower category, and a neutral move ($EVEN$) as a move to a university of the same category. The distinction can only be made when the category of the university is known. On average, we find roughly the same rate of upward and downward mobility (2%). The rate of neutral moves is slightly lower (around 1.4%). We also construct a more informative variable of mobility by looking at the difference between the category in t and the category in $t-1$ ($DCAT$).

The internal and external labor markets explanations might be related, as an individual can accept a place at a university with a lower reputation if he gets a promotion. We therefore computed the percentage of university changes that go together with a rank change and vice versa: 27% of promotions are accompanied by a change of university; 44% of university changes are accompanied by a promotion. Promotion is more likely for associate professors changing universities (61%) than for assistant professors (54%), and professors (24%).

3 Promotions

We want to analyze how the assessment of individual talent by the market evolves through time. We first regress the probability of promotion on

short run past productivity ($SRPERF$), short run past productivity interacted with experience. We will use four different measures of short run past productivity, as explained in the previous section.

We also add a number of controls: experience, experience squared, the number of years since last promotion ($YSLP$), the position before the change ($ASST$ stands for assistant professor and $ASSOC$ for associate professor).

We run a probit regression:

$$\begin{aligned} PROM^*_{it} &= \alpha_0 + \alpha_1 SRPERF_{i(t-1)} + \alpha_2 SRPERF_{i(t-1)} * EXP_{it} + \alpha_3 EXP_{it} \\ &+ \alpha_4 EXPSQ_{it} + \alpha_5 YSLP_{i(t-1)} + \alpha_6 ASST_{i(t-1)} + \alpha_7 ASSOC_{i(t-1)} + \varepsilon_{it} \end{aligned} \quad (1)$$

where

$$\begin{aligned} PROM_{it} &= 1 \text{ if } PROM^*_{it} > 0 \\ PROM_{it} &= 0 \text{ if } PROM^*_{it} \leq 0 \end{aligned}$$

Theory would lead us to expect a positive sign for α_1 and a negative sign for α_2, indicating that production matters for promotion but that the information provided by the production becomes less and less important with time.

In order to see how the assessment of productivity evolves as the individual goes up the ladder, we also interact the productivity variables with the type of promotion. We therefore run a similar regression:

$$\begin{aligned} PROM^*_{it} &= \alpha'_0 + \alpha'_1 SRPERF_{i(t-1)} + \alpha'_2 SRPERF_{it-1} * ASST_{i(t-1)} \\ &+ \alpha'_3 PERF_{it-1} * ASSOC_{i(t-1)} + \alpha'_4 EXP_{it} + \alpha'_5 EXPSQ_{it} \\ &+ \alpha'_6 YSLP_{i(t-1)} + \alpha'_7 ASST_{i(t-1)} + \alpha'_8 ASSOC_{i(t-1)} + \varepsilon'_{it} \end{aligned} \quad (2)$$

Productivity should have a larger effect on the probability of promotion at the beginning of the career. It means that we expect the effect to be more important for promotion from assistant professor to associate professor,

than for promotion from associate professor to full professor, and the least effect should be for promotions from full professor to endowed professor ($\alpha'_2 > \alpha'_3 > 0$).

We start with estimating Eq.(1). Results are provided in tables 6A (using impact factor weights) and 6B (using LP corrected impact factor weights), where we report the marginal changes and not the coefficients of the probit regressions. In column 1, we observe that production is positively related to the likelihood of promotion. Moreover, production interacted with experience has a negative effect: this appears to indicate that performance becomes less informative on the talent of the agent as he becomes more experimented. We control for the position before the promotion occurred, for experience, for the number of years since the last promotion. The same conclusions are found when estimating Eq. (2) (see column 2): the likelihood of being promoted is more related to performance in the earlier stages of an individual's career. Performance is more informative when little is known about the talent of the agent, but is still informative for the promotion from professor to endowed professor. Controlling for publication lag (columns 3 and 4) does not change the results.

We also used duration analysis (see e.g. Kiefer, 1988 for a survey) to look at the determinants of the duration of a stay in a given rank. We used a discrete time proportional hazard model (Prentice and Gloecker, 1978) and obtained similar results[11].

[11] In a previous version of the paper, we also tested whether the time spent as assistant professor has an influence on the time spent as associate professor and finds a negative relationship, i.e. evidence against systematic fast tracks.

4 Mobility

Another channel through which career concerns are likely to play a role is the outside option. Individuals might decide to exert effort not in order to be promoted, but in order to attract attention of higher ranked (and/or better paying) universities. On the other hand, departments might consider that an individual that they hired is not sufficiently well matched with the firm. In that case, he would have to find a job in another university, looking for a better match. We use three different measurements of change in university quality. In our first specification, we estimate the determinants of the probability of upward mobility (UP), i.e. the probability that an individual moves to a university in a higher category. As in the previous specification, our main interest lies in the effect of production on upward change and whether the sensitivity of upward change to production decreases with experience.

In this setting, we use the cumulative production of the individual as a measure of performance. This variable reflects the entire research history of the individual.

We run a probit regression:

$$\begin{aligned} UP^*_{it} &= \gamma_0 + \gamma_1 LRPERF_{i(t-1)} + \gamma_2 LRPERF_{i(t-1)} * EXP_{it} \\ &\quad + \gamma_3 EXP_{it} + \gamma_4 EXPSQ_{it} + \gamma_5 CAT_{i(t-1)} + \varepsilon_{it} \end{aligned} \tag{3}$$

where

$$\begin{aligned} UP_{it} &= 1 \text{ if } UP^*_{it} > 0 \\ UP_{it} &= 0 \text{ if } UP^*_{it} \leq 0 \end{aligned}$$

Another way to formulate this hypothesis is to say that the probability of a downward move $DOWN$ (a move to a lower ranked university) is negatively related to past performance. This variable is close to the termination variable used in Chevalier and Ellison (1999).

$$DOWN^*_{it} = \gamma'_0 + \gamma'_1 LRPERF_{i(t-1)} + \gamma'_2 LRPERF_{i(t-1)} * EXP_{it} + \gamma'_3 EXP_{it} + \gamma'_4 EXPSQ_{it} + \gamma'_5 CAT_{i(t-1)} + \varepsilon'_{it} \quad (4)$$

where

$$DOWN_{it} = 1 \text{ if } DOWN^*_{it} > 0$$
$$DOWN_{it} = 0 \text{ if } DOWN^*_{it} \leq 0$$

In addition we also consider a more precisely defined variable of the difference of quality. In a third specification, we use the change of category as the variable to be explained. We run in that case an ordered probit regression:

$$DCAT_{it} = \gamma''_0 + \gamma''_1 LRPERF_{i(t-1)} + \gamma''_2 LRPERF_{i(t-1)} * EXP_{it} + \gamma''_3 EXP_{it} + \gamma''_4 EXPSQ_{it} + \gamma''_5 CAT_{i(t-1)} + \varepsilon''_{it} \quad (5)$$

We first estimate Eq. (3) and run a probit regression on the probability of moving up to a better university (col. 1 in table 7). Production has a positive but small effect on the probability of moving upwards. Production interacted with experience has a negative effect on the likelihood of upward mobility. Again we interpret this finding as evidence of the career concern theory: the information provided by the production of the agent becomes less valuable as he gains experience and as the market evaluates the talent better and better. Previous category has a negative sign, indicating that it is more and more complicated to go upward.

As we expected, results for downward mobility (column 2) are reversed: past performance has a negative effect on the probability of going to a less prestigious university, but the effect becomes less important with experience.

Finally, when analyzing the change in category (Eq. 5), we find once again that production explains mobility, but less and less as experience

increases (column 3). Naturally, upward mobility appears to be less likely the higher the reputation of the university.

In line with the matching theory, we also see that the likelihood of mobility decreases with experience, except for Eq. (4), although at a decreasing rate, what could be explained by a "end-of-career" effect.

Results are similar using the LP corrected impact factor. Controlling for publication gaps, results are also comparable, except for $DOWN$, where publications and publications interacted with experience are no longer significant.

5 The Effect of Dynamic Incentives on Productivity

As a next step, we analyze whether these incentives have an effect on the behavior of economists. How sensitive is worker behavior to incentives? Does the agent exert more effort at the beginning of his career? To test this, we regress the production of individuals on the rank, the category of university where the economist work, experience and experience squared. To control for the publication lag, we lag the individual rank and the category of the university by two years.

$$\begin{aligned} PERF_{it} &= \alpha_0 + \alpha_1 Assistant_{i(t-2)} + \alpha_2 Associate_{i(t-2)} \\ &+ \alpha_3 Professor_{i(t-2)} \\ &+ \alpha_4 EXP_{it} + \alpha_5 EXPSQ_{it} \\ &+ \sum_{j=2}^{\bar{X}} \beta_j CAT_{ij(t-2)} + \varepsilon_{it} \end{aligned} \tag{6}$$

Production in this case is simply the publication in year t weighted by the impact factor. Results with the adjusted impact factor were comparable. CAT_{ij} is a dummy equal to 1 if the individual i works in a university of

category j and 0 otherwise.

So far we have detected the presence of a Bayesian learning process through which the market tries to assess the talent of the agents, supporting the existence of dynamic incentives. The next logical step is to analyze whether these incentives have an effect on the behavior of economists.

We estimate Eq. (6) using simple OLS. Results are presented in the first column of table 8. Performance appears to go up as one goes up the ladder, and individuals in more prestigious universities tend to produce more.

However an important aspect of our paper is that past production serves as an instrument of sorting and learning: an important component of productivity is the talent of the individual, which might be correlated with the rank and the category of university of the individual. We allow for unobserved heterogeneity (ϑ_i), which might be correlated with our explanatory variables ($\varepsilon_{it} = \vartheta_i + \xi_{it}$, $\xi_{it} \sim N\left(0, \sigma^2\right)$) and use a fixed effect model.

This specification assumes that there are five components to productivity: pure talent to publish, effort, a on the job human capital acquisition component, an externality component and a noise. Talent is represented by the fixed effect. We use rank dummies to test the idea that effort is declining along the career. To distinguish this strategic effect from aging effect, we control for on the job human capital acquisition by adding experience and experience squared (Becker, 1962; Ben-Porath, 1967). Externality is represented by the university category dummies. Finally, there is pure noise representing luck.

Results are supporting our hypothesis that effort is higher in the beginning of the career (see column 2 of table 8). Both the coefficients of assistant and of associate professors are positive and significant, suggesting that controlling for unobservable fixed characteristics, pre-promoted economists have higher production than the post-promoted ones. Moreover, the coefficient

of assistant professor is larger than the coefficient of associate professor, which itself is larger than the coefficient if full professor (the control group is endowed professors; similar results apply if full professors form the control group). The results also provide evidence of an efficient sorting: the category variable is no longer significant, what indicates that the more performing scholars are allocated to the more productive universities. Our results are in line with Lazear (2003): promotions are used as a sorting process and incentives provide an explanation for the Peter principle, i.e. performance declines after promotion. In addition of using category dummies, we also used the category itself as a variable, as well as the productivity of the university (as presented in table 3) and university dummies. Using the latter variable, we also found evidence of an externality effect. University productivity in $t-2$ had a positive effect on individual productivity, but the effect was smaller in the fixed effect regression than in the OLS regression, suggesting that sorting was still present. Finally, production increases with experience, but at a decreasing rate, in line with human capital theory.

We checked whether our results could be explained by the composition of our sample. Indeed, an alternative explanation could be that individuals who are still assistant or associate professors in 1998 are also more productive on average because they are included in the sample, despite the fact that they have not been present on the market over the period. To control for this possibility, we only used data for those individuals who had become professors before 1998 and found similar results.

6 The Effect of Tenure on Productivity

Tenure is an important component of academic life, especially on the North American labor market, where it is awarded only when the university con-

siders having the right match with the candidate. The tenure system has important consequences on the sorting of individuals, through the up-or-out selection scheme. However, tenure can also have a negative ex post disincentive effect, similar to a promotion. As some have pointed out, tenure is probably the most important promotion in academic life.

Therefore, we adapt the methodology of the previous section to test the effect of tenure on production. Moreover, adding tenure as an additional variable allows us to test the robustess of our previous results. The equation to be estimated is similar to Eq. (6) with the exception that a dummy variable $Tenured$ is added, equal to 1 if the individual was tenured in $t-2$ and 0 otherwise:

$$\begin{aligned} PERF_{it} &= \alpha_0' + \alpha_1' Tenured_{i(t-2)} \\ &+ \alpha_2' Assistant_{i(t-2)} + \alpha_3' Associate_{i(t-2)} \\ &+ \alpha_4' Professor_{i(t-2)} \\ &+ \alpha_5' EXP_{it} + \alpha_6' EXPSQ_{it} \\ &+ \sum_{j=2}^{\bar{X}} \beta_j' CAT_{ij(t-2)} + \varepsilon_{it} \end{aligned} \tag{7}$$

Results in table 9 are comparable to those of table 8. Therefore, our previous results are robust when we add the effect of tenure. Promotions still have an incentive effect even when controlling for the existence of tenure. We see however that the difference in the coefficients between assistant an associate profesors has been reduced, which suggests that part of the reduction of dynamic incentives for associate profesors is due to the fact that many of them are tenured. Indeed, we find the unsurprising result that tenure has an additional negative effect.

7 Discussion and Conclusion

In this paper, we have analyzed the labor market for a sample of top economists by linking promotion and upward mobility to research productivity. We have found evidence that production was positively related to promotion and upward mobility but decreasingly with experience, in line with the career concern literature. Learning about talent leads to the allocation of individuals inside the firm and between firms.

We have found also that economists respond to dynamic incentives: effort is higher at the beginning of the career when incentives are stronger. Sorting and matching appear to play an important role as well: over the career, individuals are allocated to universities according to their respective productivity.

Our results can easily be explained in a simple model like Holmstrom (1982) but where firms differ in their ability to attract finance, itself being a function of reputation. As a consequence, they can "afford" to hire different types of individuals.

We provide a sketch of the model. There are two types of firms (sectors), A and B, and two periods. Both types of firms set standards but at a different level. Type A firms set a standard equal to $\underline{\vartheta}$, while type B firms set the standard at $\overline{\vartheta}$. Think of these two types of firms as serving different segment of the market: for example, type A firms are more teaching oriented and type B firms more research oriented. Both types value talent equally. However, type A firms have a financial constraint. They can only afford to pay the agent until $\overline{\vartheta}$. Type B firms have no cash constraint. Individuals are initially allocated to firms based on the expected talent $m_{i0} = E(\vartheta_i)$.

Production of the agent is the sum of talent, effort and a noise.

$$y_{it} = \vartheta_i + a_{it} + \varepsilon_{it}$$

where $\varepsilon \sim N\left(0, \sigma_\varepsilon^2\right)$ i.i.d. and $\vartheta \sim N\left(m_0, \sigma_\vartheta^2\right)$.

Assume the individual is initially allocated to a type A firm. After one period, firms observe y_{i1} and update their beliefs:

$$m_{i1} = E\left(\vartheta_i \mid z_{i1}, a_1^*\right) = \frac{h_1}{h_1 + h_\varepsilon} m_0 + \frac{h_\varepsilon}{h_1 + h_\varepsilon} z_{i1}$$

where $h_1 = \dfrac{1}{\sigma_\vartheta^2}$, $h_\varepsilon = \dfrac{1}{\sigma_\varepsilon^2}$, $z_{i1} = y_{i1} - a_1^*$ and a_1^* is the level of effort anticipated by the firms.

If the new expected value of talent $E\left(\vartheta_i \mid z_{i1}, a_1^*\right)$ falls below the threshold $\underline{\vartheta}$, the individual leaves firm A, leaves academia and gets an outside option $\underline{\vartheta}$. If $\underline{\vartheta} < E\left(\vartheta_i \mid z_{i1}, a_1^*\right) < \overline{\vartheta}$, the individual stays in firm A. He is then "promoted". Finally, if $E\left(\vartheta_i \mid z_{i1}, a_1^*\right) > \overline{\vartheta}$, then the individual moves to a type B firm. A symmetric explanation is valid if the individual is initially allocated to a type B firm. Therefore, as a consequence, individuals are matched to firms based on their talent, which is only individual specific.

Second, exactly like in Holmstrom's model, effort declines with experience, as firms learn about the talent of individuals. In period 2, the agent exerts no effort. In period 1, the agent selects effort so as to maximize expected utility:

$$\max_{a_1} m_0 + \delta E\left(\vartheta_i \mid z_{i1}, a_1^*\right) - g\left(a_1\right)$$

$$\rightarrow \quad g'\left(a_1\right) = \delta \frac{h_\varepsilon}{h_1 + h_\varepsilon}$$

where $g(a_t)$ is the cost of effort, $g\prime > 0$, $g" > 0$.

The model can easily be generalized to $n > 2$ periods and $j > 2$ types of firms. The main results remain unchanged. First, learning implies reallocation of workers. Second, learning also implies that reallocation becomes less likely with time. Third, effort decreases with time.

We have neglected a series of issues. Maybe the most important is the multitasking aspect of the academic activity. Research output clearly only represents one aspect of the job of an academic and other activities - as teaching, administrative duties, consulting, and political activities - have to be taken into account. We argued that top economists are more likely to be employed in institutions that emphasize research. Moreover, our summary statistics using current cross sectional information suggest that teaching diminishes along the career. Therefore, it can not be the case that differences in the number of teaching hours are an explanation for the decline of effort along the career. This is not necessarily true for the other activities, especially for administrative duties. This possibility raises the issue of the optimal allocation of tasks along the career for academic scientists (see Smeets, 2003 for a theoretical analysis).

Other interesting issues for future research are whether there is serial correlation in wages and promotions in the academic world, and whether career concerns are associated with herding behavior, although this issue is probably less important than in financial activities.

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Table 1: number of individuals by number of years of experience in 1998

	Nr. of ind.	**%**
$EXP \leq 10$	105	16.10%
$10 < EXP \leq 20$	325	49.85%
$20 < EXP \leq 30$	158	24.23%
$30 < EXP \leq 40$	50	7.67%
$40 < EXP \leq 50$	11	1.69%
$EXP > 50$	3	0.46%

Table 2: Most represented PhD institutions

	Nr.	%
1. MIT	97	14.9%
2. Harvard	80	12.3%
3. Chicago	53	8.1%
4. Stanford	39	6%
5. Princeton	35	5.4%
6. Berkeley	32	4.9%
7. Yale	26	4%
8. Northwestern	21	3.2%
9. LSE	20	3.1%
10. Minnesota	17	2.6%
Total	420	64.3%

Table 3: research productivity of the top 20 research departments in economics (number of pages in top journals adjusted for size)

Rank	University	1970-1974	Rank	University	1974-1978	Rank	University	1978-1983
1	Harvard	2272.6	1	Chicago	2247.94	1	Chicago	2976.1
2	Chicago	1603.4	2	Harvard	2007.11	2	Harvard	2427.4
3	Yale	1354.4	3	Stanford	1747.38	3	Stanford	1996.1
4	Wisconsin	1277.5	4	Wisconsin	1349.21	4	Pennsylvania	1660
5	Stanford	1201.4	5	Pennsylvania	1287.36	5	Yale	1502.9
6	MIT	1115.1	6	MIT	1088.9	6	Northwestern	1461.6
7	Pennsylvania	1090.4	7	Yale	978.29	7	MIT	1442.2
8	Princeton	1051.8	8	UCLA	958.9	8	Wisconsin	1386
9	Berkeley	995.2	9	Berkeley	946.98	9	Berkeley	1281.2
10	UCLA	870.7	10	Princeton	891.39	10	UCLA	1246.3
11	Carnegie-Mellon	854	11	Northwestern	858.58	11	Cornell	1236.6
12	Michigan	840.6	12	Michigan	768.41	12	Columbia	1229.1
13	Northwestern	823.6	13	Washington-Seattle	703.72	13	Princeton	1186.6
14	Washington-Seattle	806.7	14	Rochester	692.72	14	Minnesota	1123.5
15	Rochester	724.5	15	Illinois-Urbana	687.78	15	Michigan	1062.4
16	Minnesota	674.6	16	North Carolina	686	16	Rochester	983.5
17	Illinois	594.2	17	Columbia	681.36	17	Illinois-Urbana	941
18	Brown	574.8	18	NYU	674.01	18	NYU	901.3
19	SUNY-Buffalo	547.7	19	Ohio State	621.32	19	Carnegie-Mellon	900.8
20	Michigan State	532.6	20	Minnesota	608.63	20	Washington-Seattle	877.6

Rank	University	1984-1993	Rank	University	1990-1994	Rank	University	1994-1998
1	Harvard	6867.1	1	Chicago	2974.05	1	Harvard	3481.20
2	Chicago	6767.2	2	Harvard	2814.45	2	Chicago	3054.75
3	Pennsylvania	5734.6	3	Northwestern U	2397.57	3	MIT	2309.61
4	MIT	5387.8	4	Pennsylvania	2274.23	4	Pennsylvania	2291.18
5	Northwestern	5175.8	5	MIT	2172.09	5	Northwestern	1986.65
6	Stanford	4971.6	6	Stanford	1984.05	6	Stanford	1790.85
7	Princeton	4434.4	7	Michigan	1795.64	7	UCLA	1679.67
8	Michigan	3867.7	8	UCLA	1746.80	8	Berkeley	1556.00
9	Berkeley	3863.1	9	Yale	1630.41	9	NYU	1526.11
10	UCLA	3805.8	10	Princeton	1606.23	10	Michigan	1482.63
11	Yale	3574.2	11	Berkeley	1579.97	11	Yale	1382.49
12	Columbia	3539.1	12	Columbia	1423.83	12	Princeton	1346.17
13	NYU	2732	13	NYU	1317.19	13	Cornell	1214.38
14	Rochester	2717.7	14	Duke	1215.86	14	Columbia	1180.63
15	Wisconsin	2642.9	15	Cornell	1152.11	15	Wisconsin	1072.51
16	Carnegie-Mellon	2612.5	16	Rochester	1088.78	16	Duke	891.39
17	Cornell	2602.2	17	Wisconsin	1063.92	17	UCSD	880.20
18	Duke	2557.6	18	LSE	1044.62	18	Ohio State	869.66
19	Illinois-Urbana	2366.4	19	Ohio State	962.06	19	LSE	858.77
20	Minnesota	2100.8	20	Illinois-Urbana	944.23	20	Minnesota	807.47

Source: Niemi (1975), Graves et al. (1982), Hirsch et al. (1984), Scott and Mitias (1996) and Coupé (2000)

Table 4: The proportion of movers

		% people	# people
number of moves	0	29.1	179
	1	39.3	242
	2	22.6	139
	3	5.8	36
	4	1.8	12
	5	0.9	6
	6	0.15	1
			615

Table 5: Probability of university change by rank

Rank	# obs.	probability of university change
assistant professor	2655	10.9%
associate professor	1972	9.8%
professor	4337	4.1%
endowed professor	1672	3.6%

Table 6A: Effect of performance on promotion (probit estimation)

Dep. var.: $PROM_{it}$	Articles weighted by the impact factor			
			correcting for publication lag	
	(1)	(2)	(3)	(4)
Short run past performance	0.0198*** (0.002)	0.0043*** (0.0014)	0.0146*** (0.0017)	0.0044*** (0.0015)
Short run past performance*Experience	-0.0008*** (0.0001)	-	-0.0005*** (0.0001)	-
Short run past performance*Assistant in $t-1$	-	0.0183*** (0.0026)	-	0.0111*** (0.0023)
Short run past performance*Associate in $t-1$	-	0.0110*** (0.0025)	-	0.0071*** (0.0025)
Years since last promotion in $t-1$	0.0099*** (0.0014)	0.0057*** (0.0015)	0.0110*** (0.0014)	0.0059*** (0.0016)
Years since last promotion in $t-1$*Assistant in $t-1$	-	0.0203*** (0.0031)	-	0.0270*** (0.0032)
Years since last promotion in $t-1$*Associate in $t-1$	-	0.0249*** (0.0032)	-	0.0251*** (0.0033)
Assistant in $t-1$	0.4141*** (0.0244))	0.0565** (0.0306)	0.3841*** (0.0240)	0.0326 (0.0299)
Associate in $t-1$	0.3250*** (0.0180)	0.0436* (0.0252)	0.3368*** (0.0187)	0.0697*** (0.0274)
Experience	0.0252*** (0.0023)	0.0089*** (0.0027)	0.0274*** (0.0024)	0.0095*** (0.0028)
Experience squared	-0.0007*** (0.0001)	-0.0003*** (0.0001)	-0.0008*** (0.0001)	-0.0004*** (0.0001)
Nr. Obs.	8704	8704	8453	8453
Log likelihood	-2820.40	-2764.09	-2786.66	-2732.32
Pseudo R^2	0.15	0.17	0.14	0.16

Note: marginal changes; standard errors in parentheses; ***/**/* denote resp. significance at 1%/5%/10%

Table 6B: Effect of performance on promotion (probit estimation)

Dep. var.: $PROM_{it}$	Articles weighted by the corrected LP impact factor			
			correcting for publication lag	
	(1)	(2)	(3)	(4)
Short run past performance	0.0859*** (0.0080)	0.0204*** (0.0064)	0.0646*** (0.0075)	0.0188*** (0.0067)
Short run past performance*Experience	-0.0034*** (0.0007)	-	-0.0024*** (0.0007)	-
Short run past performance*Assistant in $t-1$	-	0.0801*** (0.0115)	-	0.0504*** (0.0102)
Short run past performance*Associate in $t-1$	-	0.0424*** (0.0109)	-	0.0321*** (0.0112)
Years since last promotion in $t-1$	0.0099*** (0.0014)	0.0057*** (0.0015)	0.0111*** (0.0014)	0.0059*** (0.0016)
Years since last promotion in $t-1$*Assistant in $t-1$	-	0.0209*** (0.0031)	-	0.0276*** (0.0032)
Years since last promotion in $t-1$*Associate in $t-1$	-	0.0246*** (0.0032)	-	0.0250*** (0.0033)
Assistant in $t-1$	0.4144*** (0.0244)	0.0556* (0.0307)	0.3855*** (0.0240)	0.0298 (0.0299)
Associate in $t-1$	0.3245*** (0.0180)	0.0530** (0.0257)	0.3370*** (0.0187)	0.0699*** (0.0273)
Experience	0.0257*** (0.0023)	0.0089*** (0.0027)	0.0279*** (0.0024)	0.0098*** (0.0028)
Experience squared	-0.0007*** (0.0001)	-0.0003*** (0.0001)	-0.0008*** (0.0001)	-0.0004*** (0.0001)
Nr. Obs.	8704	8704	8453	8453
Log likelihood	-2824.03	-2765.03	-2784.82	-2729.59
Pseudo R^2	0.15	0.17	0.14	0.16

Note: marginal changes; t-stat equivalent in parentheses; ***/**/* denote resp. significance at 1%/5%/10%

Table 7: Effect of long run past performance on mobility (probit and ordered probit estimation) using the impact factor weight

Dep.var.	UP_{it}	$DOWN_{it}$	$DCAT_{it}$
	probit		ordered probit
Long term past performance	0.0012***	-0.0007**	0.0154***
	(0.0004)	(0.0003)	(0.0031)
Long term past performance*Experience	-0.000032*	0.000025*	-0.0004***
	(0.000019)	(0.000013)	(0.0001)
Experience	-0.0031***	0.00022	-0.0316***
	(0.0008)	(0.00072)	(0.007)
Experience squared	0.000055*	-0.000047*	0.0009***
	(0.000031)	(0.000028)	(0.0002)
Category in t-1	-0.0092***	0.0083***	-0.184***
	(0.001)	(0.001)	(0.011)
Nr. Obs.	8615	9601	9769
Log likelihood	-938.42	-1010.29	-4499.59
Pseudo R^2	0.06	0.06	0.03

Note: marginal changes for the probit regression, coefficients for the ordered probit; standard errors in parentheses; ***/**/* denote resp. significance at 1%/5%/10%

Table 8: the determinants of productivity

Dep. var.:	Impact factor		LP corrected impact factor	
	(1)	(2)	(3)	(4)
	OLS	Fixed Effect	OLS	Fixed effect
Assistant in $t-2$	-0.589*** (0.085)	0.475*** (0.108)	-0.132*** (0.019)	0.106*** (0.024)
Associate in $t-2$	-0.449*** (0.073)	0.370*** (0.089)	-0.096*** (0.016)	0.087*** (0.020)
Professor in $t-2$	-0.152*** (0.054)	0.158** (0.067)	0.025** (0.012)	0.047*** (0.015)
Category 2 in $t-2$	0.074 (0.142)	-0.072 (0.198)	0.041 (0.031)	0.012 (0.044)
Category 3 in $t-2$	0.108 (0.136)	-0.022 (0.200)	0.050* (0.030)	0.020 (0.044)
Category 4 in $t-2$	0.355*** (0.132)	0.056 (0.202)	0.109*** (0.029)	0.028 (0.045)
Category 5 in $t-2$	0.455*** (0.131)	0.061 (0.203)	0.129*** (0.029)	0.026 (0.045)
Category 6 in $t-2$	0.732*** (0.131)	0.063 (0.206)	0.175*** (0.029)	0.024 (0.046)
Category 7 in $t-2$	0.965*** (0.136)	0.157 (0.222)	0.243*** (0.030)	0.058 (0.049)
Experience	-0.049*** (0.009)	0.032*** (0.010)	-0.015*** (0.002)	0.002 (0.002)
Experience squared	0.001*** (0.0001)	-0.001*** (0.0002)	0.0002*** (0.00004)	-0.0003*** (0.00005)
Constant	1.679*** (0.164)	1.046*** (0.228)	0.369*** (0.036)	0.255*** (0.051)
Adj.R^2	0.036	0.203	0.036	0.189
Nr.Obs.	9325	9325	9325	9325

Note: standard errors in parentheses, ***/**/* denote resp. significance at 1%/5%/10%.

Table 9: the effect of tenure on productivity

Dep. var.:	Impact factor		LP corrected impact factor	
	(1)	(2)	(3)	(4)
	OLS	Fixed Effect	OLS	Fixed effect
Tenure in $t-2$	0.095 (0.083)	-0.186*** (0.093)	0.024 (0.018)	-0.037* (0.021)
Assistant in $t-2$	-0.411*** (0.117)	0.350** (0.148)	-0.107*** (0.026)	0.080*** (0.033)
Associate in $t-2$	-0.379*** (0.087)	0.330*** (0.108)	-0.089*** (0.019)	0.079*** (0.024)
Professor in $t-2$	-0.228*** (0.063)	0.107 (0.080)	-0.040*** (0.014)	0.036** (0.018)
Category 2 in $t-2$	-0.053 (0.167)	0.019 (0.237)	0.018 (0.037)	0.027 (0.053)
Category 3 in $t-2$	-0.031 (0.159)	0.023 (0.241)	0.023 (0.035)	0.026 (0.054)
Category 4 in $t-2$	0.225 (0.157)	0.096 (0.242)	0.084** (0.035)	0.036 (0.054)
Category 5 in $t-2$	0.349** (0.155)	0.104 (0.244)	0.111*** (0.034)	0.029 (0.054)
Category 6 in $t-2$	0.584*** (0.156)	0.129 (0.249)	0.150*** (0.034)	0.034 (0.055)
Category 7 in $t-2$	0.768*** (0.164)	0.187 (0.275)	0.212*** (0.036)	0.048 (0.061)
Experience	-0.040*** (0.013)	0.047*** (0.015)	-0.015*** (0.003)	0.005 (0.003)
Experience squared	0.0007** (0.0003)	-0.001*** (0.0004)	0.0003*** (0.00006)	-0.0003*** (0.0001)
Constant	1.628 (0.207)	0.984*** (0.290)	0.373*** (0.046)	0.244*** (0.065)
Adj.R^2	0.03	0.15	0.03	0.15
Nr.Obs.	5784	5784	5784	5784

Note: standard errors in parentheses, ***/**/* denote resp. significance at 1%/5%/10%.

Table A1: Summary statistics

Variable	# obs.	# of ind.	Mean	Standard deviation	Min	Max
Experience	12038	652	11.59	8.93	0	57
Assistant professor	12038	652	0.22	0.42	0	1
Associate professor	12038	652	0.17	0.38	0	1
Full professor	12038	652	0.39	0.49	0	1
Endowed professor	12038	652	0.16	0.36	0	1
Out of academe	12038	652	0.06	0.23	0	1
Category	10540	620	4.76	1.49	1	7
PROM	10716	620	0.108	0.310	0	1
UCH	10716	620	0.068	0.251	0	1
UP	10568	620	0.020	0.141	0	1
DOWN	10568	620	0.021	0.145	0	1
EVEN	10568	620	0.014	0.116	0	1
DCAT	9769	620	-0.009	0.471	-5	5

Table A1 (cont'd.)

Variable	# obs.	# of ind.	Mean	Standard deviation	Min	max
# OF PUBLICATIONS WEIGHTED BY THE IMPACT FACTOR						
Current performance						
Performance in t	12038	652	1.34	1.60	0	21.53
Short run past performance						
Performance from $t-3$ to $t-1$	11632	652	3.74	3.49	0	48.86
Performance from $t-1$ to $t+1$ (controlling for publication lag)	11207	652	4.03	3.43	0	48.86
Long run past performance						
Performance from 1969 to $t-1$	11386	652	15.53	17.38	0	179.42
Performance from 1969 to $t+1$ (controlling for publication gap)	11386	652	16.91	17.79	0	181.90
# OF PUBLICATIONS WEIGHTED BY THE LP CORRECTED IMPACT FACTOR						
Current performance						
Performance in t	12038	652	0.29	0.35	0	4.74
Short run past performance						
Performance from $t-3$ to $t-1$	11632	652	0.81	0.76	0	10.41
Performance from $t-1$ to $t+1$ (controlling for publication lag)	11207	652	0.87	0.75	0	10.41
Long run past performance						
Performance from 1969 to $t-1$	11386	652	3.50	3.83	0	38.53
Performance from 1969 to $t+1$ (controlling for publication gap)	11386	652	3.79	3.91	0	38.61