Incentive vs. Sorting: The Wage Policy of U.S. Economics Departments*

Tom Coupé
EERC-EROC and KIE, Kyiv

Valérie Smeets
Center for Corporate Performance, Aarhus School of Business

Frédéric Warzynski†
Center for Corporate Performance, Aarhus School of Business

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Abstract

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†Corresponding author. Address: Universidad Carlos III, Department of Business Administration, Calle Madrid 126, 28903 Getafe (Madrid), Spain. Email: fwarzyns@emp.uc3m.es

In this paper, we propose a series of empirical tests that try to assess which of the various theories that have been designed to explain the wage policy of firms better suits economics departments. We consider two closely related incentive theories -tournaments and standards- and learning theory. We use a dataset of average wages by rank in U.S. economics departments over the period 1977-1997 and link this information to individual production data. We analyze what are the determinants of the wage structure and what are the effects of these policies on the behavior of economists. We find that the wage gap is increasing along the hierarchy, even when controlling for differences in production between ranks. Moreover, wages are more sensitive to productivity for higher ranks. We find some evidence that higher wage gaps lead to higher productivity but not that wage gaps depend on the number of contestants nor that they lead to less cooperation. Our findings provide evidence in favor of all these theories, but our tests are designed to distinguish between their different effects. In particular, we find that, while on average, departments appear to use standards rather than tournaments, the choice between the two depends on the type of promotion, department quality and who else the department can hire.

JEL Codes: J0, M5

Keywords: incentives, sorting, tournaments, standards, learning, selection, economic departments

"No matter what we may say, none of us is a philosopher-saint, and you can't fully understand the development of economic ideas without a sense of the structure of rewards that economists face",

Paul Krugman, Incidents from my career,
www.wws.princeton.edu/~pkrugman/incidents.html

1 Introduction

What are the firms' concerns regarding their wage and promotion policies? Theory suggests that they care about providing incentives to workers (e.g. Lazear and Rosen, 1981) while avoiding dysfunctional responses or lack of cooperation (e.g. Lazear, 1989); about providing incentives to invest in human capital (e.g. Prendergast, 1993); about learning about workers' abilities and selecting the most able (e.g. Gibbons and Farber, 1996), assigning individuals to their most productive use (e.g. Rosen, 1982) and paying them accordingly. Wages therefore are set for incentive purposes, but also as a consequence of a learning and selection process within the organization.

Empirical tests to date have mostly focused on testing implications from one or another of these theories, without systematically trying to distinguish between them. This limitation has been noted in recent surveys of empirical contract theory (Gibbs, 1994; Gibbons, 1997; Prendergast, 1999). One noticeable exception is Baker, Gibbs and Holmström (1994b). Using individual data from a single firm, they describe the key elements of the wage policy of this firm and link them to what different theories (learning, on-the-job human capital acquisition and incentives theories) would have predicted. They conclude that their findings are not entirely compatible with any of these theories considered separately, suggesting as an alternative to combine them

in a single framework. This work, together with their companion paper, has generated a new line of theoretical research integrating building-block models (learning, task assignment and on the job human capital acquisition) to explain some of these (previously unexplained) findings, which has been relatively successful achieving this aim (Gibbons and Waldman, 1999a, 1999b, 2003).

In this paper, we analyze the wage policy of U.S. economics departments over the period 1977-1997. Through a series of empirical tests, we try to better understand which theories can be helpful to explain the wage policy of economics departments. We consider two closely related incentives theories - tournaments and standards - and learning theory leading to selection and sorting[1]. We focus our analysis on symmetric learning but also discuss implications from asymmetric learning. We ignore task assignment since a specificity of the academic labor market is that individuals are not assigned to different tasks when they are promoted. We also consider explicitly the outside labor market to allow policies to change according to the supply of adequate candidates, both inside and outside the firm.

Up-or-out contracts are another specifity of the academic labor market. The literature has typically considered this type of contracts to be a credible way to solve the double moral hazard problem where the firm wants the employee to invest in human capital and the employee wants the firm to commit rewarding him for this investment (Kahn and Huberman, 1988). Prendergast (1993) and Ghosh and Waldman (2004) note that promotions will not provide sufficient incentives for firms if not accompanied with a task reassignment where human capital is more valuable. For occupations like academia, where this can be seen as a realistic assumption, up-or-out will

[1] We also discuss implications of human capital theory, although it is less central in our empirical analysis. The reasons are clearly explained in section 4.

do a better job. On the other hand, tenure and promotion decisions are also considered as a way to select individuals for their ability and provide incentives to workers. For these purposes, tenure is a tool complementary to promotions. In practice, in many universities, tenure is offered at the same time than the promotion to associate professor. Therefore, while promotions (and tenure) are used as incentives and selection mechanisms in academia, up-or-out contracts offer a better way to induce individuals to invest in human capital.

Economists studying the U.S. academic labor market have discussed the relevance of these theories. First, while there seems to be some support for the fact that departments use promotion and tenure[2] prospects to provide incentives to younger workers, and while the type of contest looks like a relative performance evaluation (many players competing for a prize associated with promotion), it is relatively unclear whether the evaluation is done relative to a fixed pre-established threshold or to the performance of the other contestants. Another aspect that needs to be clarified is the influence of external recruitment on the provision of incentives to insiders. An important advantage of subjective and also relative performance evaluation - particularly relevant in the academic environment- is that, despite the fact that research performance is publically observable, it allows to incorporate other dimensions of the job (teaching, externalities,...) when ranking individuals. Second, departments also appear to learn whether younger members have the ability to be promoted to a higher rank, leading to a selection process through which higher ability candidates are allocated to the highest ranks where their skills are rewarded. Related to this, a strand of research has estimated how wages varied with past cumulative performance, indicating

[2] Another specificity of academic labor markets is the use of up-or-out contracts associated with the tenure system (Kahn and Huberman, 1988). We discuss how it relates to our analysis in section 4.

that the market rewards the ability to publish research (see e.g. Moore, Newman and Turnbull, 2001 for a recent exercise). Our empirical analysis considers these different theories in a single integrated framework, in the spirit of Gibbons and Waldman, adapted to the peculiarities of the academic labor market.

We try to answer two questions: first, what are the main determinants of the wage policy of economics departments; second, and more importantly, does the wage structure influence the "behavior" of economists. To answer these questions, we link our "average wage by rank" dataset to individual productivity and cooperation data to assess the causes and consequences of wage gaps. We use the composition of economics departments in the 107 universities which were ranked by the NRC in 1993 and link the names to the bibliographic information provided by EconLit. We also use the fact that we have information on the entire population of the department to compute the average productivity by rank. This is important because it allows us to link wage gaps to differences in past productivity between ranks, therefore controlling for the selection effect.

Results show that selection and incentives matter in economics departments, but also that, to identify the effects of one theory, empirical work has to control for other potential explanations. Our findings also suggest that, while on average, departments appear to use standards rather than tournaments, the choice between the two depends on the type of promotion, department quality and who else the department can hire.

The next section describes the empirical methodology and discusses the implications of the various theories. We then describe our unique dataset, carry on our empirical analysis and discuss the implications of our results.

2 Theory and Empirical Predictions

This section compares implications from tournament theory, standards, and learning and selection theory. It also discusses the intuition of our empirical strategy to distinguish between these three theories.

2.1 Tournaments

Tournaments are a simple form of relative performance evaluation (RPE) where people get promoted if they are ranked first and beat their competitors. The prize associated with the promotion generates incentives to exert effort. This theory has been applied to promotions along the hierarchy, most importantly to describe CEO succession but also more generally to describe the allocation of individuals to higher responsibility levels along the hierarchy through sequential contests. An important prediction of tournament theory is that the value of winning should increase as one goes up the promotion ladder (Rosen, 1986). The intuition is that in a sequential game with risk averse agents, N stages and s stages remaining to be played, prizes are increasing in survival: $\Delta W_s > 0 \ \forall s$. Winning one step further gives the option to continue, but since there are fewer steps remaining, the option value that determines the incentives of the players plays out, so the wage gap must reflect the loss of the survival option[3].

Another prediction of tournament theory with a single prize is that the wage spread should be higher the more there are contestants for the prize (see McLaughlin, 1988 for a discussion; see also Nalebuff and Stiglitz, 1983).

[3] Under risk neutrality, the incentive maintaining prize structure consists of constant prizes until the last promotion, where there is discrete jump. Such a wage distribution can also be seen as a result of repeated static tournaments rather than the generation of an option in repeated tournaments (Prendergast, 1999).

This is a very intuitive finding: the more people are fighting for a prize, the harder it is to win it, and the higher the prize should be to provide the same level of incentives. While equilibrium effort is not affected, the wage spread is increasing in the number of contestants. As noted by Eriksson (1999), it is less obvious to find how the level of effort affects the probability of winning as the number of contestants increases[4].

The most direct implication of tournament theory is that effort is increasing with the prize, therefore higher wage gaps should be associated with higher productivity. However, higher wage gaps can also reduce cooperative behavior among contestants (Lazear, 1989). It might therefore be efficient to have lower wage gaps to avoid this negative sabotage behavior, at the expense of lower productive effort.

The empirical literature testing tournament theory has found support for some of these implications, focusing on top executives (see e.g. Eriksson, 1999; Conyon et al., 1999 and Bognanno, 2001 for recent exercises), selecting by construction only the absolute top of the hierarchy and proxying individual productivity by firm performance; or more naturally on sport tournaments (see e.g. Ehrenberg and Bognanno, 1990a&b and Becker and Huselid, 1992), where individual performance is immediately retrievable, but hierarchies are absent. However, the most important criticism against existing papers is that most studies did not test tournaments against other theories[5] like standards or theories of hierarchical production where workers

[4] Allowing for multiple prizes further complicates the analysis. See Gibbs (1996) for a detailed analysis.

[5] O'Reilly, Main and Crystal (1988) test tournament theory against social comparison theory. Lambert, Larcker and Weigelt (1993) test tournaments together with managerial power and agency theory. Main, O'Reilly and Wade (1993) test tournament theory against wage compression. However, none of these papers consider standards as an alternative to tournaments, nor try to distinguish incentives from selection effect.

are assigned to their most productive use. These theories can have similar predictions (Gibbs, 1994, 1996; Prendergast, 1999). A way to cope with this problem has recently been advanced by Eriksson (1999). He proposed to test multiple predictions from tournament theory with the same dataset. He argues that this provides a sharper test of tournament theory because the alternative theories do not generate all the same predictions. While we also test multiple predictions from various theories, we follow a different approach: we run a series of empirical tests that try to distinguish between the effects of these different theories. We see this as the main contribution of the paper. The academic profession combines two important aspects that are vital for our analysis. First, individuals are allocated within a well-established three-layers hierarchy. Second, we can measure individual research productivity and cooperation since entry on the labor market, and, therefore, at each hierarchical level, by looking at publications patterns. We discuss in the rest of the section what other theories predict and how our empirical analysis allows to distinguish between them.

2.2 Standards

Standards are another simple form of promotion scheme, where all individuals who reach an established threshold are promoted[6]. Instead of beating their competitor (a moving target), workers must now beat the standard established ex ante by the firm. Therefore the wage gap has the same incentive property than in the tournament model. It is also still the case that the wage gap is increasing, following the same reasoning. However, the other contestants of the game are not true competitors if the standard is fixed, therefore the number of contestants should not be associated with higher wage gaps, nor should higher wage gaps be associated with less coop-

[6] The discussion is based on Gibbs (1996).

eration. Standards are therefore a safeguard against the potential negative sabotaging effects of tournaments.

There are other differences between standards and tournaments that are worth stressing. First, standards do not filter out the common term. When there is a lot of common uncertainty, tournaments provide a form of insurance from the external environment. Second, by imposing a minimum level of absolute performance, standards provide a better selection of individuals than tournaments. Third, under tournaments, the number of positions available is fixed while it varies according to performance in the case of standards. Therefore, if a position needs to be filled, firms are more likely to resort to tournaments.

2.3 Learning, Selection and Sorting

In learning theory (See Gibbons and Katz, 1992; Farber and Gibbons, 1996; see also the discussion in Baker, Gibbs and Murphy, 1994b), firms are initially uncertain about the ability of their workers when they hire them. By observing their performance, they gradually extract information about workers' ability. An important consequence of learning theory is that individuals are selected to be promoted on the basis of their expected ability. In firms, learning about ability can be especially important if ability is more valuable in the higher levels of the hierarchy. Selected individuals are then rewarded according to their marginal productivity. Importantly for our analysis, the academic labor market differs from that description on at least two key aspects. First, unlike what happens in most firms, economists do the same job in all layers. A promotion is not associated with a new task assignment, at least not to the same extent than in firms. Individuals in lower levels are not really subordinates who receive orders from individuals in the higher

ranks. However, talent in the high ranks can generate positive externalities on those below them. Second, the literature studying individual wages in the academic labor market has shown that economists are not paid according to their marginal research productivity. Instead, individual wages in the academic labor market are set on the basis of past achievements or "reputational capital" (Moore, Newman and Turnbull, 2001). Increasing wage gaps could then also reflect the fact that higher ranked individuals have been selected based on their past productivity. By the same token, if the more able individuals are sorted in the higher wage universities and if individuals have reached the higher ranks following a selection process, then the fact that higher wage gaps lead to higher productivity could also be a consequence of the sorting effect, rather than reflecting the incentive effect. This theory of learning and selection has no clear implication concerning the effect of the number of contestants on the wage gap or the effect of the wage gap on cooperation. What is important though is to control for the selection effect if we want to test implications from the other theories.

2.4 Our Approach

Our empirical strategy is the following. We test 1) whether wage gaps are increasing along the hierarchy; 2) whether the number of contestants has an effect on the wage gap; whether higher wage gaps are associated 3) with higher research productivity and/or 4) less cooperation. We compare the results with what standards and tournament theory would predict, controlling (and testing) for learning and selection theory. As shown above, these two incentive theories have conflicting implications regarding the effect of the number of individual by rank on the prize and the consequences of the size of the prize on cooperation. We control for selection by disaggregating the wage gap in two components: one part that reflects past productivity

differentials and a residual that reflects incentives. The procedure is described in details in section 4. We then analyze the importance of external recruitment and look at the effect of department quality on the wage policy. This brings additional light on our results.

3 Data

3.1 University Level Data

Every year the American Economic Association (AEA) sends to economics departments the *Universal Academic Questionnaire* (UAQ) where information is asked on, among other things, average salaries by category of jobs (assistant, associate and full professors), the size of the department by category and the number of degrees awarded.

We use the answers to these surveys for the years 1977 to 1997, providing a total of 2,100 observations[7]or on average 100 departments a year. Salaries are deflated using the GDP-implicit price deflator (the base year is 1998).

Average real wages have increased over time for all 3 categories. In 1977, an economics department paid on average 64,000 $ to its professors, in 1997 it was about 85,000$. The average wage for associate professors increased from 48,000$ to 63,000$ and from 38,000$ to 53,000$ for assistant professors.

Figure 1 shows the evolution of the average wage gap. While the wage

[7] Unfortunately, only few departments have participated every year so we have an unbalanced panel. From 2,338 university-year pairs, we further excluded observations where we did not have information on all ranks (186 cases), where the average salary was less then 10,000 $ (8 outliers), and where the natural rank order was not observed (44 -mostly when assistant professors average wage was higher than associate professors wage). Results were not affected by the cleaning.

difference between associate and full professors has remained quite constant over time, the gap between assistant professors and the other categories has decreased over time. More importantly for our analysis, this indicates that the average wage gap is increasing with the job level: in 1998, on average, the gap between the salary of an assistant professor and the salary of an associate professor was about 19% while the gap between the salary of an associate professor and the salary of a full professor was about 35%.

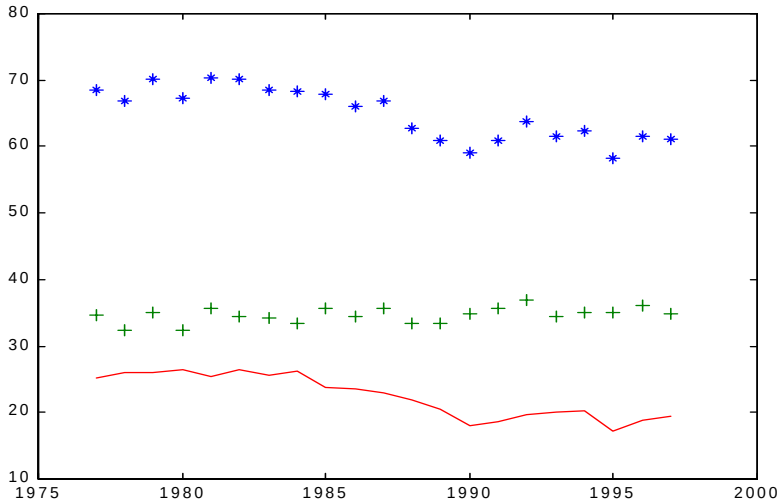
Another interesting feature of our dataset is that the variance increases with rank as well (Table 1). This could suggest that promotions lead to pay differentiation, while pay is relatively similar at the assistant professor level.

These stylized facts can be explained by incentives, learning or human capital theories, as discussed in the introduction. We test their relevance in the next section.

3.2 Internal Labor Markets and External Competition

The UAQ also provides information on the number of hires, promotions and leaves by year and by rank. Using all observations for which we have data on the number of faculty in t and $t-1$, and on the internal and external moves, we compute three variables: the percentage of individuals leaving the department by year and by rank, the percentage of individuals new in their rank (promoted from the inside or hired from the outside) by year and by rank, and the percentage of newly hired individuals coming from outside the department by year and by rank. Table 2 shows the average of these three variables.

Figure 1: The evolution of the gaps between different ranks



— associate vs assistant +++ prof vs associate *** full prof vs assistant

Table 1: Average wage and standard deviation by rank

	Mean	Std. dev.
W_{asst}	52,588	5,879
W_{assoc}	62,837	10,323
W_{prof}	84,750	18,272

Table 2: Average internal and outside mobility

Rank	% of individuals leaving the department	% of individuals new in their rank	% of individuals new in their rank hired from the outside
Professors	3.6 %	5.5 %	28 %
Associates	3 %	12.1 %	25 %
Assistants	11.3 %	19.1 %	95.8 %

The average percentage of individuals leaving the department is relatively small for associate and full professors, but much higher for assistant professors. On the other hand, the average percentage of individuals who are new in their rank is decreasing with rank, and very large at the assistant professor level. Moreover, 96% of the new assistant professors are hired from the outside, this percentage decreases dramatically with rank. These statistics are consistent with the idea of internal competition for jobs. But around one quarter of new individuals are still hired from the outside at the higher ranks, suggesting that external competition also plays a non negligible role. We therefore include it in our empirical analysis.

3.3 Individual Data

We further use information about the entire population of individuals related to 107 universities which were ranked by the NRC in 1993[8]. This dataset contains 2,673 individuals and provides the name, rank and university to

[8] As a robustness check, we also used the 7th and the 9th edition of the *Guide to Graduate Study in Economics* to get information on the faculty of the departments. The 7th edition (academic years 1982-1984) gives for each department, the names of the faculty and their rank (from assistant to full professor). The 9th edition (academic year 1994-1995) in addition gives information on the date and the university of Ph.D. though sometimes lacks information on ranks. In a longer version of the paper, we also show the results using this alternative source.

which they are affiliated during the academic year 1992-1993. These names were linked to the bibliographic information in EconLit. This allows us not only to look at the performance of individuals in terms of research but also gives us the possibility to look at their cooperative behavior (through coauthorship).

The department composition, together with the bibliographic record of each individual, was then matched with the wage dataset. Wages for each layer were available for 50 universities, among them 13 are private. This provides information about 1,291 individuals. More than half of them are full professors (694 individuals or 53.8% of the sample), the category of associate professors is composed of 292 individuals (or 22.6% of the sample) and the others are assistant professors (305 individuals, or 23.6% of the sample).

4 Empirical Analysis

4.1 Increasing Wage Gaps

Our first test is to determine whether the wage gap is increasing along the promotion ladder. We look at the effect of the job level on average wage and test whether the coefficient is increasing. We regress the log of average wage on a dummy for associate, a dummy for full professor and some controls.

$$\log W_{jrt} = \alpha_0 + \alpha_1 ASSO + \alpha_2 PROF + \alpha_3 Z_{jt} + \varepsilon_{jrt} \tag{1}$$

where j is an index for the university, r is an index for rank ($r = PROF$, $ASSO$,$ASST$) and t is a time index. The variables included as controls (Z) are a dummy for private universities and the size of the university (measured by the number of degrees awarded, in hundreds), the latest being slightly less well reported. Results are presented in table 3.

Table 3: Wages and ranks

Dep.var.: $\log W$	(1)	(2)
$ASSO$	0.20*** (0.005)	0.20*** (0.004)
$PROF$	0.49*** (0.005)	0.49*** (0.004)
Nr.BA	-	0.07*** (0.004)
$PRIV$	-	0.05*** (0.002)
constant	10.63*** (0.004)	10.57*** (0.004)
Year dummies	NO	YES
Nr.Obs.	6300	5721
Adj. R^2	0.56	0.75

Note: standard errors in parentheses, ***/**/* denotes statistical significance at the 1%/5%/10% level

We find evidence of an increasing relationship between wage and the job level. As one moves up in the hierarchy, the gap increases. As can be seen in the first column, job levels alone explain 56% of the variance. Size of the institution and its ownership also play an important role in wage determination.

The finding that the wage gap is increasing can be explained by various theories. Sequential tournaments and standards both generate the implication that the prize associated with promotions should be increasing along the hierarchy. However, wage differentials could simply reflect differences in life-time achievements if individuals at the top of the hierarchy have been selected on the basis of their productivity. Finally, human capital theory would also predict that wages increase with experience. Therefore, increasing wage gaps could also reflect differences in human capital accumulation.

To control for selection, we need a measure of performance for each

hierarchical layer. To disaggregate university production by category of job, we use the list of the names and the ranks of individuals working in the department as provided in the 1993 survey of the NRC. For each individual, we constructed the publication history between 1969 and 1998 from EconLit. This allows us to compute the mean number of publications per rank for each of the 107 doctoral programs included in the NRC survey.

Publications are adjusted for quality and corrected for coauthorship, dividing the weight of the paper by the number of coauthors. Different quality weights have been proposed in the literature. We selected one methodology, suggested in Bauwens (1998): each journal receives a weight between one and five on the basis of the product of the impact factor and the total number of citations received during a given year (the latter reflecting better the long run) and then gives weight 1 to journals not included in the Journal Citation Report (JCR) but included in Econlit, because the non-JCR included journals are quite likely to be rarely cited ones. This method has the advantage of being simple and of weighting all journals. One disadvantage is that weights can be seen as relatively subjective. We also used publications weighted by the impact factor of the journal and obtained similar results.

We link the cross section information on the composition of economics departments and their publication to the information about wages for the year 1992. We find a match for 50 universities. It is important to stress once again that, while we gain some insight on the potential variables influencing wages, we lose the time dimension. We were unfortunately not able to follow the career of individuals[9] as the survey was not continued in subsequent years.

[9] In Coupé et al. (2006), we follow the career of a sample of 1,000 top economists and linked their productivity to their career achievements, but without information about individual wages.

To control for the possibility that wage gaps reflect differences in average past publications, we create a variable called average past publication by rank ($PPUB$) by summing all papers published from 1969 until 1992 of those individuals present in university j and rank r in 1992, and dividing the sum by the number of individuals by rank. We then regress the log of wage by rank on the log of $PPUB$ by rank, controlling for ranks:

$$\log W_{jr} = \delta_0 + \delta_1 ASSO + \delta_2 PROF + \delta_3 \log PPUB_{jr} + \varepsilon_{jr} \qquad (2)$$

In the first column of table 4, we find that publications matter, but also that promotion premia are lower when controlling for production differentials. The raw gaps for this subsample of 50 universities are 19% (from assistant to associate) and 54% (from associate to professor). Correcting for past performance, we get gaps of 8% and 38%. Despite this reduction is size, we still find increasing wage gaps.

Table 4: Wages and past performance

Dep.var.:	$\log W$	$\log W_{prof}$	$\log W_{ASSO}$	$\log W_{ASST}$
constant	10.57*** (0.03)	10.37*** (0.14)	10.61*** (0.1)	10.79*** (0.02)
$\log PPUB$	0.08*** (0.02)	0.27*** (0.04)	0.13*** (0.03)	0.02 (0.015)
$ASSO$	0.08** (0.03)	-	-	-
$PROF$	0.38*** (0.04)	-	-	-
Nr.Obs	150	50		
Adj. R^2	0.79	0.50	0.22	0.01

Note: see table 3

We also ran the equation for each rank separately:

$$\log W_{jr} = \gamma_0 + \gamma_1 \log PPUB_{jr} + \varepsilon'_{jr} \forall r \qquad (3)$$

Columns 2 to 4 present the results. An interesting finding is that wages

are more performance related at higher levels of the hierarchy. This appears to indicate a learning and selection effect, the most productive scholars being allocated to the more lucrative positions. This result can be linked to the stylized fact that the variance of wages was more important for higher ranks. The results remain valid when we control for the same variables used in table 3, but the number of observations then drops to 39 when we add the number of degrees awarded as a control of size because this variable is less well reported.

To control for (non time-varying) omitted variables and university fixed effects in the salary level, we regress the difference of the log wages on the difference of the log past publications[10].

Table 5: Wage gaps and past publication differences

Dep.var.:	$\log W_{PROF} - \log W_{ASSO}$	$\log W_{ASSO} - \log W_{ASST}$
constant	0.28^{***} (0.026)	0.15^{***} (0.022)
$\log PPUB_{PROF} - \log PPUB_{ASSO}$	0.12^{***} (0.034)	-
$\log PPUB_{ASSO} - \log PPUB_{ASST}$	-	0.027^{**} (0.01)
Nr.Obs	50	50
Adj. R^2	0.18	0.06

Note: see table 3

Results are presented in table 5. We find a positive effect of publication: higher wage gaps are partly explained by higher past publication gaps. Moreover, the difference in the constant again indicates an increasing wage gap. Finally, the sensitivity of wage gaps to productivity differences increases along the career.

[10] Note that we are not able to control for university-by-rank fixed effects in this specification. We would have needed a panel dataset to properly address this concern.

Human capital theory predicts that wages are linked to seniority if individuals accumulate on-the-job human capital. Therefore, an alternative explanation for increasing wage gaps could be differences in average experience. We checked this hypothesis using individual data of the 9th *Guide to Graduate Study in Economics* which gave for some universities the year of Ph.D, allowing us to compute the average experience level by rank. Controlling for differences in past publications, we did not find a significant effect of the difference in average experience level on the wage gap. This finding could be due to the lack of sufficient variation in *average* experience level by rank.

Another potential explanation is that wage increases are imposed on departments because it reveals private information about worker's performance to the market (Waldman, 1984; Bernhardt, 1995). Despite the fact that research performance is publically observable, it could be that the market values some of the other skills important in the academic profession and that firms have private information about them.

There are also some elements that could explain the variation across departments for which we can not control such as differences in teaching loads. However, given the relative (compared to publications) unobservability of the quality of teaching, universities are less able to provide incentives in this area. What they could do though is to include the subjective information in the promotion decision.

To sum up, economics departments have increasing wage gaps and this finding can not be entirely explained by performance differentials. This suggests that incentive-related motivations might lie at the origin of this finding. We also find evidence of learning and selection, as wages become more performance related at higher ranks. We analyze these issues further by performing additional tests.

4.2 The Prize and the Number of Contestants

The second hypothesis that we want to test is whether the wage gap between job ladders is a function of the number of participants. The more there are participants, the harder it should be to win the prize, and therefore, *ex ante*, a bigger reward should be needed to provide sufficient incentives to contestants. We therefore regress the wage gap between the full professor level and the associate professor level on the number of associate professors waiting for promotion, controlling for size and type of institution:

$$\log GAP_{j,PROF-ASSO} = f(NR.ASSO_j, PRIV_j, SIZE_j) \tag{4}$$

Similarly, we regress the wage gap between the associate professor level and the assistant professor level on the number of assistant professors and the same controls:

$$\log GAP_{j,ASSO-ASST} = f(NR.ASST_j, PRIV_j, SIZE_j) \tag{5}$$

Results are provided in table 6. The number of contenders is positively and significantly related to the wage spread, in line with tournament theory. The more people are fighting for the prize, the larger should the prize be. The relationship is apparently stronger for the gap at the lower level ($GAP_{ASSO-ASST}$).

There are two problems associated with our specification. The first difficulty is that part of the wage gap reflects differences in average past productivity between ranks, as we have seen in the previous subsection, so that we would like to distinguish the selection effect from the incentive effect.

Table 6: Effect of the number of contestants on the wage gap

Dep.var.:	$\log GAP_{PROF-ASSO}$	$\log GAP_{ASSO-ASST}$
Nr. Contestants	0.017*** (0.004)	0.019*** (0.005)
Nr.BA	0.18*** (0.01)	0.12*** (0.015)
PRIV	0.33*** (0.028)	0.23*** (0.03)
constant	9.30*** (0.005)	8.85*** (0.06)
Nr.Obs.	1853	1852
Adj. R^2	0.19	0.10

Note: see table 3

To control for this selection effect, we create a corrected wage gap, i.e. a measure of the wage gap "purified" from the selection effect. We first regress the log of the wage gap on the log of the gap in average cumulative publications (as in Table 5). The part which is not explained by the publication differential is the corrected wage gap ($CGAP$).

We then regress the corrected wage gap on the number of contestants. This corrected wage gap measures the part of the wage gap not accounted by the selection effect and is therefore more likely to reflect incentives provided by the promotion prize.

$$CGAP_{j,PROF-ASSO} = f(NR.CONTESTANTS_j) \tag{6}$$

$$CGAP_{j,ASSO-ASST} = f(NR.\ CONTESTANTS_j) \tag{7}$$

Results are reported in table 7. We find a positive and slightly significant effect of the number of assistant professors, but a negative - though not significant - effect of the number of associate professors. This result can be linked to the observed hierarchical structure of economics departments. Contrarily to firms where the hierarchy is organized in a pyramide-like scheme, the largest layer in departments is composed of professors, while the number

of associates is usually smaller than the number of assistants. This could explain why there seems to be a tournament effect in the first round of promotion (from assistant to associate), but not in the second. Alltogether, we do not find a clear effect of the number of contestants on the wage gap.

Table 7: Effect of the number of contestants on the corrected wage gap

Dep.var.:	$CGAP_{PROF-ASSO}$	$CGAP_{ASSO-ASST}$
Nr. Contestants	-0.006 (-0.005)	0.007* (0.004)
constant	0.32*** (0.035)	0.11*** (0.02)
Nr.Obs.	50	50
Adj. R^2	0.01	0.04

Note: see table 3

The second problem is that we use the absolute number of contestants. By doing this, we do not control for the number of positions available. In the literature on firms one generally takes the number of board members (in other words, divided by 1 CEO)[11]. A solution could be to divide the number of contestants by the number of existing positions in the upper level. Indeed one could argue that the probability to be promoted will increase with the number of existing positions. However, the fact that there are many people in the higher ranks can also mean that the positions have been filled recently. Our results were not qualitatively different when we used this other definition. We carry on a more precise analysis of slots in section 5.

[11] Eriksson (1999) finds that for each additional manager with "significant" responsibilities, the wage gap increase by 1.8%. Conyon et al. (2001) find that each additional board-member increases the gap by 3.5%. Bognanno (2001) finally shows that each additional vice president increases the gap between the president and the vice-presidents salary by 4%.

4.3 Incentive Effect

Do economists at the assistant and associate level produce more in universities with higher wage gaps? Are people responding to incentives? To check this, we test whether we can find a relationship between production on the one hand and wage gap on the other. To avoid reversed causality, we use individual publications (weighted for coauthorship and adjusted for quality, as for past publications) during the period 1993-1995 as a measure of performance ($PERF$).

We regress this productivity variable on the log of the wage gap in the university where the individual is affiliated:

$$PERF_i = \lambda_0 + \lambda_1 GAP_{jr} + \lambda_2 ASSO + \varepsilon_i \tag{8}$$

where GAP_{jr} is $\log GAP_{j,ASSO-ASST}$ if individual i is assistant professor and $\log GAP_{j,PROF-ASSO}$ if he is associate. We find a positive and significant effect of the wage gap on individual performance (table 8 column 1). A doubling of the wage gap would lead to an increase of the average production by rank of 1 AER-equivalent article. Assistant professors in our sample appear to be more productive than associate professors, also in line with various incentive theories[12].

[12] This comparison could only reflect cross-sectional differences between individuals in the subsamples, and not necessarily a dynamic reduction of productivity after the first promotion (on the latest see Coupé, Smeets and Warzynski, 2006).

Table 8: Effect of the wage gap on performance

Dep.var.: $PERF$	(1)	(2)
GAP	5.35** (2.15)	-
$CGAP$	-	7.83*** (2.31)
ASSO	-2.37*** (0.55)	-1.46*** (0.45)
constant	4.95*** (0.53)	5.95*** (0.32)
Nr.Obs.	597	
Adj. R^2	0.03	0.04

Note: see table 3

As discussed in section 2, this result could as well be explained by a selection effect if the more productive individuals are also working in the higher wage universities. Therefore, we use once again the corrected wage gap instead of the observed wage gap to control for the selection effect:

$$PERF_i = \lambda_0' + \lambda_1' CGAP_{jr} + \lambda_2' ASSO_i + \varepsilon_i' \tag{9}$$

Results are presented in column 2. We see that when we use the part of the wage gap reflecting "pure incentives", we find a more important effect of the wage gap, a doubling of the corrected wage gap being associated with an increase by 1.5 AER equivalent article on average. This result suggests that wage gaps have a strong incentive effect once we control for selection, in line with incentive theories.

4.4 Cooperation

A disadvantage of tournament is that they will decrease the willingness to cooperate with colleagues of the same rank. While internal collaboration with colleagues of the same rank increases individual output, it also increases the output of a competitor. Additionally, the market might have

difficulty finding out the respective contributions of each author, creating a free rider problem. We ask two questions: first, do professors collaborate more internally (within department) within rank as they are not in competition anymore? Second, do we find more 'internal within rank' cooperation in departments that have smaller wage gaps?

To test these two hypotheses, we create a variable called internal cooperation within rank ($ICWR$) by dividing the number of papers coauthored within university within rank (i.e. with other contestants) by the total number of publications, over the period 1993-1995. We also create a variable called cooperation ($COOP$) by dividing the number of coauthored papers by the total number of papers over the same period. This variable measures all types of cooperation (internal and external, within rank and between ranks). To provide a snapshot of how cooperative behavior depends on rank, average internal cooperation within rank and cooperation are presented in table 9.

Table 9: Cooperation and rank

	$COOP$	$ICWR$
Assistant	0.57 (0.37)	0.05 (0.16)
Associate	0.71 (0.36)	0.03 (0.13)
Professor	0.64 (0.38)	0.06 (0.19)

Note: standard deviations in parentheses

We find that, among those economists who published at least one paper over the period (949 individuals or 73.5% of the sample), 63.5% of the papers are coauthored. Moreover, associate professors are those who cooperated more during that period. On the other hand, they are also those who cooperated less within rank. However, the number of associate professors is

often smaller than the number of assistant professors and much smaller than the number of professors. We take this into account by adding the number of colleagues by rank as an additional control in the empirical analysis (see below).

We then relate $ICWR$ to the log of the wage gap as in the previous subsection. Because there are a lot of people who do not cooperate at all or cooperate on all their papers, we prefer to use a dichotomic variable as dependent variable and create a dummy $DICWR$ equal to 1 if individual cooperated internally within rank on at least one paper and 0 otherwise. Individuals who did not publish did not cooperate neither and were assigned value of 0 (we relax this assumption infra). In our sample, 43 assistant professors (around 14% of the sample) and 23 associate professors (around 8% of the sample) cooperated within rank.

We run a probit analysis:

$$ICWR_i^* = \mu_0 + \mu_1 GAP_{jr} + \mu_2 ASSO_i + \varepsilon_i$$

$$\begin{aligned} DICWR_i &= 1 \text{ if } ICWR_i^* > 0 \\ DICWR_i &= 0 \text{ if } ICWR_i^* \leq 0 \end{aligned}$$

Colum 1 of table 10 shows the marginal changes. We find negative but not significant effect of the wage gap. Cooperative behavior within rank does not appear to be affected by wage gaps. On the other hand, we find that associate professors tend to cooperate significantly less within rank.

Finally, we run a similar probit analysis using the corrected wage gap as explanatory variable:

$$ICWR_i^* = \mu_0' + \mu_1' CGAP_{jr} + \mu_2' ASSO_i + \varepsilon_i$$

Column 2 shows that the same conclusions prevail, as the corrected wage gap does not affect significantly cooperation within rank and associate professors appear to cooperate less internally within rank.

Table 10: Effect of the wage gap on cooperation

Dep.var.: $DICWR$	(1)	(2)
GAP	-0.078 (0.129)	-
$CGAP$	-	0.146 (0.136)
$ASSO$	-0.052* (0.03)	-0.059** (0.025)
Nr.Obs.	597	
Pseudo R^2	0.02	0.02
Log likelihood	-204.4	-204

Note: see table 3

We also added the number of colleagues by rank as an additional control but results were unchanged. However, when we considered the subsample of only those individuals who published, then the associate professor dummy was no longer significant and the number of colleagues had a positive effect on internal cooperation within rank.

The fact that cooperation within rank is not affected by the wage gap would suggest that individuals do not consider themselves as competitors fighting for a single prize. This is an implication of standard theory. Another explanation could be that our variable provides a limited information due to the fact that cooperation within rank is not a major aspect of academic research that departments might want to promote. A more general notion of cooperation would be to provide useful comments on papers or helping each other by discussing problems. However, it is hard to quantify these rather unobservable actions, so that our variable is the best proxy we can think of. It could also be the case that, on the contrary, departments care

a lot about cooperation within rank and include this variable (observable within the department) rather subjectively in the promotion decision, so that dysfunctional responses are discouraged.

5 External Hiring and Department Quality

The evidence so far confirms the importance of selection. Part of the wage gap between hierarchical layers can be explained by differences in past publication. It also stresses the importance of incentives. Controlling for selection, the wage gap is increasing along the hierarchy and has a strong effect of the productivity of individuals concerned with potential promotion. However, it is hard to say which incentive theory suits better the wage policy of economics departments. On the one hand, the wage gap does not affect internal cooperation within rank, in line with standard theory, but what can also be explained by other factors. On the other hand, the number of contestants does not affect the wage gap between professors and associate professors, again in line with standard theory; but has a positive effect on the wage gap between associate and assistant professors, as implied by tournament theory. Therefore, both models appear to be relevant, though at different stages of the career. In this section, we try to clarify our findings by introducing external recruitment and by investigating whether the wage policy is affected by department research quality.

5.1 Competition from Outsiders and the Wage Gap

Figures in table 2 showed that, while 75% of new associate professors and 72% of new full professors were promoted internally, a sizeable fraction of newly appointed individuals in a rank were recruited from outside the de-

partment. This evidence contradicts at least partially the use of tournaments or standards where contestants are isolated from the outside labor market. Chan (1996) proposes an extension of the tournament model where firms can hire individuals from the outside or promote their own candidates externally. When firms decide to recruit from the outside, they destroy partially the incentives provided to their internal candidates. One solution to this problem is to raise the wage gap to counterbalance the loss of incentives. The firm can also handicap outside competitors, hitherto hiring outsiders only if their expected ability is significantly larger than the expected ability of internal contestants.

We compute the share of individuals recruited from the outside at the associate level and at the professor level by looking at the average past recruitment policy of the firm. We then test whether the share of individuals hired from the outside at rank r has an effect on the corrected wage gap between rank r and rank $r-1$.

We find that the share of full professors hired from the outside is positively related with the corrected wage gap, in line with the prediction of Chan (table 11). However, the share of associate professors hired from the outside has no effect on the corrected wage gap. How to explain these findings? According to Chan's analysis, the internal promotion rate will also depend on the supply of talented insiders and outsiders. Indeed, we observe a lot of variation in the number of individuals promoted from the inside and hired from the outside within the same department.

Table 11: Effect of the external recruitment rate on the corrected wage gap

Dep.var.:	$CGAP_{PROF-ASSO}$	$CGAP_{ASSO-ASST}$
Share of ind. externally recruited	0.185** (0.084)	0.034 (0.069)
Nr. Contestants	-0.006 (0.005)	0.007* (0.004)
constant	0.257*** (0.044)	0.104*** (0.031)
Nr.Obs.	50	50
Adj. R^2	0.08	0.03

Note: see table 3

Additionally, while the supply of talented individuals could be time varying, demand could also depend on how many individuals by rank left the department, suggesting the creation of open slots, and of other factors such as the department budget.

To control for these factors, we looked at the relationship between the number of internal promotions, the number of external recruitments and the number of departures by rank, controlling for changes in department size (see Appendix A). We found that the number of internal promotions to full professor were relatively unaffected by the number of departures, while external recruitments were positively related to departures. Moreover there was a positive relationship between internal and external hires. On the other hand, both the number of internal promotions and external recruitments were positively related to the number of departures for associate professors. However, there was a much stronger relationship in the case of internal promotions. This suggests that assistant professors are relatively insulated from outside competition.

This additional evidence confirms our previous finding that assistant professors appear to compete against each other (subsection 4.2). This could

explain why the promotion rate is more responsive to the creation of new slots, while relatively not affected by the rate of external recruitment. On the other hand, when positions of full professor become available, departments rely more on the outside labor market and have higher wage gaps. The findings in this subsection also support the alternative interpretation that departments run tournaments subject to who else they can get.

5.2 Tournaments, Standards and Department Quality

An additional way, suggested by Gibbs (1994), to distinguish between tournaments and standards (controlling for selection) is to examine the extent to which job slots are fixed. Fixed slots are a key element of tournament theory, suggesting competition for positions that have to be filled. To check this, we looked whether the organizational structure remained stable over time by comparing the share of each hierarchical layer in 1983 and 1992. On average, these shares changed by about 10% over a ten year period, which again goes in favor of standards.

However, this test assumes a relatively homogeneous policy, what could be considered unrealistic. In this subsection, we test whether there is some variation between departments in the type of policy followed. More specifically, we look at the effect of department quality on the decision to run a tournament or a standard. At first sight, we would expect departments with higher reputation to be more concerned with quality. Therefore, according to the discussion in section 2, standards would be a more appropriate way to control for quality. On the other hand, casual observation suggests that top departments also have more fixed slots, in line with a tournament type of contest. How can these two elements go together?

First, we tested the effect of the department quality and the corrected

wage gap interacted with quality on internal cooperation within rank. We used the NRC ranking of research quality as a measure of the quality of the department. We found that individuals in higher quality departments cooperate less internally in absolute level, and that the wage gap interacted with department level has a negative effect on internal cooperation within rank (Appendix B). This lack of cooperation is typically the type of dysfunctional responses that tournaments would lead to, and that we did not find when we did not control for department quality. This can be interpreted as a sign that people in better departments are more "hawkish" than "dovish".

Second, we also looked at the relationship between the corrected wage gap, the number of contestants, department quality and internal promotion rate. Using simple correlations, we found that the best departments have higher corrected wage gaps; they have more assistant professors and less associate professors; they hire more from the outside; and they also have more stable hierarchies: the relative composition of each job category was relatively constant in higher quality departments, while it varied much more for other departments.

Departments with better reputation therefore appear to rely more on tournaments and at the same time to recruit more from the outside labor market. This policy provides an alternative selection mechanism for high quality individuals where competition is not restricted to insiders by selecting the best individuals on the market. This also clarifies the previous finding that departments run tournaments subject to who else they can get. Only higher quality departments do. Others appear to use standards and have more flexibility with job slots.

6 Discussion and Conclusion

We have used a very rich panel dataset providing average wage and department size at each level of the economics departments' hierarchy over more than twenty years to test empirically which theories better explain their wage policy. We have provided evidence that learning and selection matters, but also that incentives are an important element to explain the wage structure. We have found that wage gaps are increasing with the job level, even when controlling for differences in productivity by rank. In addition, average wages increase with productivity along the career, suggesting the presence of sorting, as the more productive economists are being matched with the more productive universities, which also pay higher wages. Individual productivity is also positively linked to wage gaps, i.e. wage gaps have an incentive effect. On the other hand, we have not found strong evidence that the number of contestants influences wage gaps, nor that wage gaps are associated with less cooperation among contestants. These findings would tend to support, on average, the existence of standards rather than tournaments in economic departments. However, there are signs that departments use tournaments rather than standards at the beginning of the career; and that higher quality departments also appear to use tournaments rather than standards, while also relying more on outsiders. This would suggest that top departments value quality so much that they restrict their demand to the best potential candidate either on the internal or the external labor market. These findings raise new theoretical questions about the conditions under which standards or tournaments will be more likely to be chosen, and stress the importance of reputation and market position.

The costs and benefits of using one rather than another promotion system could vary over time, depend on the supply of talented individuals or on

the budget constraint of the organization. Another aspect to be considered is the dynamic nature of the way relative performance evaluation schemes are set. While considered as exogenous by the contestants, they are established by the organization so as to guarantee a given level of sorting and are probably set by learning by doing, i.e. by observing the effect of previously established policies on the (past) talent pool and can be interpreted as a tournament against the past. These remarks imply that the distinction between standards and tournaments is less clear cut in reality. These issues are left for future research.

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Appendix A:

Table A.1: Correlations between the number of professors who left the department, the number of professors hired from the outside by the department and the number of associate professors promoted internally to full professor

	Professors who left	Professors hired from the outside	Associate professors promoted internally to professor
Professors who left	1	-	-
Professors hired from the outside	0.30	1	-
Associate professors promoted internally to full professor	0.10	0.18	1

Table A.2: Correlations between the number of associate professors who left the department, the number of associate professors hired from the outside by the department and the number of assistant professors promoted internally to associate

	Associate professors who left	Associate professors hired from the outside	Assistant professor promoted internally to associate professor
Associate professors who left	1	-	-
Associate professors hired from the outside	0.20	1	-
Assistant professor promoted internally to associate professor	0.31	0.16	1

Appendix B

Table B.1: Effect of the wage gap on cooperation

Dep.var.: $DICWR$	(1)	(2)
$CGAP$	1.68*** (0.018)	1.37*** (0.42)
CGAP*NRC93	-0.56** (0.22)	-0.47*** (0.16)
$ASSO$	-0.049* (0.03)	-0.055** (0.024)
NRC93	-0.046*** (0.018)	-0.029*** (0.014)
Number of colleagues of same rank	0.01* (0.005))	0.005 (0.004)
Nr.Obs.	461	597
Pseudo R^2	0.06	0.05
Log likelihood	-178.62	-196.77

Note: see table 3. Column 1 only includes individuals who have published at least one paper.

Column 2 includes all individuals and assigns a value of 0 to DICWR.