

Incentives in Economic Departments: Testing Tournament Theory?*

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Still preliminary version, comments welcome

Abstract

We use a dataset of average wages by rank in US economic departments over the period 1977-1997 to test empirical implications of tournament theory (Lazear and Rosen, 1981) against other theories that have similar effects, like standards and basic marginal productivity theory (Gibbs, 1995; Prendergast, 1999). We link this information to individual production data to test whether wage gaps affect the productivity and cooperative behavior of economists and to control for marginal productivity theory. We find that the wage gap is increasing along the hierarchy, even when controlling for production by rank. 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. These findings tend to go in favor of the use of standards rather than tournaments in economic departments.

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“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

A large literature has examined how relative performance evaluation (RPE) schemes are helpful to improve the incentives provided by an organization to its employees and to induce sorting of the most able individuals. In this paper, we analyze the wage policy of U.S. economic departments over the period 1977-1997 and link it to tournament theory (Lazear and Rosen, 1981), the first and more popular of these RPE theories. Tournament theory has several implications about the way wages are structured in the hierarchy so as to generate incentives and about the way individuals react to these incentives.

The empirical literature testing tournament theory has mostly focused on executive pay (see e.g. Eriksson, 1999; Conyon et al., 1999 and Bognanno, 2001 for recent exercises), where only the absolute top of the hierarchy was considered and individual productivity was proxied 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.

We extend the analysis to the academic world and more specifically to the case of economic departments. The academic profession combines two important aspects: first, there is a well-established three-layers hierarchy, and second, it is possible to obtain measures of individual productivity and cooperation since entry on the labor market, and therefore at each hierarchical level, by looking at publications patterns. In a more and more competitive academic environment, wage policy should be a key tool not only for providing incentives but also for keeping and reallocating scarce talent.

Another important criticism against existing papers is that most studies did not test tournaments against other theories like standards or basic theories of marginal productivity that have similar predictions (Gibbs, 1995; Prendergast, 1999).

We try to answer two questions. What are the main determinants of the wage policy in an economic department, and more importantly, does the wage structure influence the behavior of economists and how? Our main contribution is to test tournaments theory against standards and marginal productivity.

To answer these questions, we link our university level wage dataset to individual productivity and cooperation data to assess the consequences of wage gaps. We use the composition of economic departments in the 107 universities which were ranked by the NRC in 1993 and link 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, so as to link the wage gap to the differences of productivity of the different ranks to control for marginal productivity theory.

We find that the wage gaps are increasing with rank. This finding is robust when controlling for productivity differences, and productivity differences also explain part of the wage gap. Wages become more linked to performance at higher ranks, indicating a sorting effect as more productive individuals are allocated to higher pay jobs along the career. We also find evidence that wage gaps lead to more productivity. However, the wage gap does not appear to be affected by the number of contestants, nor does it influence cooperation among contestants. The evidence therefore suggests the use of standards rather than tournaments in economic departments, and also the existence of a learning process about the talent of individuals along the career, resulting in the sorting of individuals.

2 Theory and Empirical Predictions

2.1 Tournaments

Tournaments are a simple form of RPE. People are being rewarded for being the first, such as a sprinter winning a race or an high-rank executive being promoted to CEO. We provide hereafter a simplified version of Lazear and Rosen (1981).

The output produced by individual i is stochastic and depends on effort a :

$$q_i = a_i + \varepsilon_i$$

There is a cost of effort $\Psi(a_i)$. There exists another worker j with similar characteristics.

Suppose the wage of the worker is a combination of a fixed part t and a prize for winning W , so that the expected payment is $t + pW$, where p is the probability of winning the tournament:

$$p = \Pr(q_i > q_j) = \Pr(a_i - a_j > \varepsilon_j - \varepsilon_i) = G(a_i - a_j)$$

where G is the cumulative distribution of normal $\varepsilon_j - \varepsilon_i$ with mean 0 and variance $2\sigma^2$.

The agent therefore selects effort that maximises his utility function $t + pW - \Psi(a)$:

$$Wg(a_i - a_j) = \Psi'(a_i)$$

By symmetry $a_i = a_j$. Assuming for simplicity that $\Psi(a) = \frac{a^2}{2}$, by selecting $W = \frac{1}{g(0)}$ the principal can achieve the first best. More generally, the higher the gap, the higher the effort exerted by the contestants.

This literature has since been extended and detailing the various developments is beyond the scope of this paper. We focus our attention to testable hypotheses.

Hypothesis 1: the value of winning should increase as one goes up the promotion ladder (Rosen, 1986).

The intuition is that in a sequential game with 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.

Hypothesis 2: the wage spread should be higher the more there are contestant for the prize (Nalebuff and Stiglitz, 1983)

This is a very intuitive finding: the more people are fighting for a prize, the more difficult is it to obtain it, and the higher the prize should be to provide the same level of incentives. While equilibrium effort is not affected, the wage spreads depends on the number of contestants (see also McLaughlin, 1988).

Hypothesis 3: higher wage gaps should be associated with higher productivity

This proceeds directly from the theory, as higher gaps lead to better incentives. This implies that universities with higher gaps will perform better, either in terms of publications or in terms of rankings.

Hypothesis 4: higher wage gaps should reduce cooperative behavior among contestants (Lazear, 1989)

While competition among contestants provides incentives to exert more effort, it could also discourage contestants to cooperate, or even induce them to sabotage each other's work. It might therefore be efficient to have lower wage gaps to avoid this negative sabotage behavior, at the expense of lower productive effort.

2.2 Standards

Standards are another simple form of promotion scheme, where all individuals who reach an established threshold are promoted. In that case, it is still the case that propositions 1 and 3 hold, but not propositions 2 and 4, because the other contestants of the game are not true competitors. However, contestants are still incentivized by the contest prize and the prize must be structured with that aim. Standards are therefore a safeguard against the potential negative sabotaging effects of tournaments. While considered as exogenous by the contestants, standards are established by the organization so as to guarantee a given level of sorting. One way to see it is that standards are actually set by learning by doing, i.e. by observing the effect of previously established standards on the talent pool and constitute dynamically an evolving set of rules¹.

2.3 Marginal Productivity Theory

Marginal productivity theory simply implies that agents are rewarded according to their productivity. In that case, increasing wage gaps could also reflect the fact that higher ranked individuals are more productive. Talent

¹We thank Ed Lazear for suggesting this aspect.

reveals itself as individuals start producing. Sorting emerges as a consequence of the survival game, as exit and reallocation proceeds. If the more able individuals are sorted in the higher wage universities, then the fact that higher wage gaps lead to higher productivity (proposition 3) could also be a consequence of the sorting effect, rather than reflecting the incentive effect. There are no clear implication concerning propositions 2 and 4.

3 Data

3.1 University Level Data

Every year the American Economic Association (AEA) sends to economic 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 observations² 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 economic department paid on average 64,000 \$ to its professors, in 1997 it was about 85,000\$. The average wage of associate professors increased from 48,000\$ to 63,000\$ and the assistant professors from 38,000\$ to 53,000\$.

Figure 2 shows the evolution of the wage gap. While the wage 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.

²Unfortunately, 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 than 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. One should be aware of two additional features: first, the number of participants in the UAQ has been declining over time, we have 116 observations in 1977 against 79 in 1997. Second, the composition of our sample changes from one year to another, for example, Washington University is present each year, Princeton is present 12 years and Harvard only once.

Figure 1: The evolution of the wage gap between categories of job

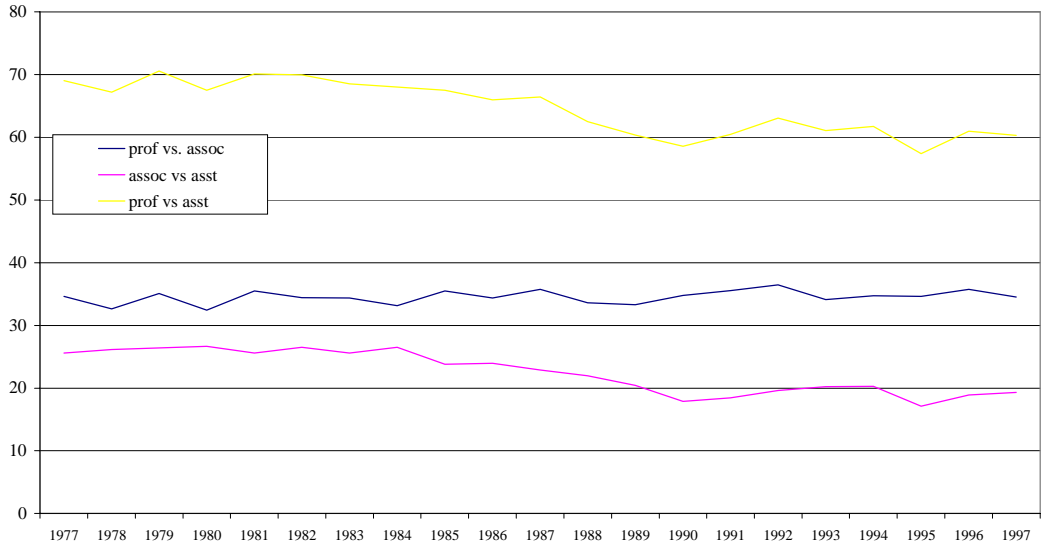
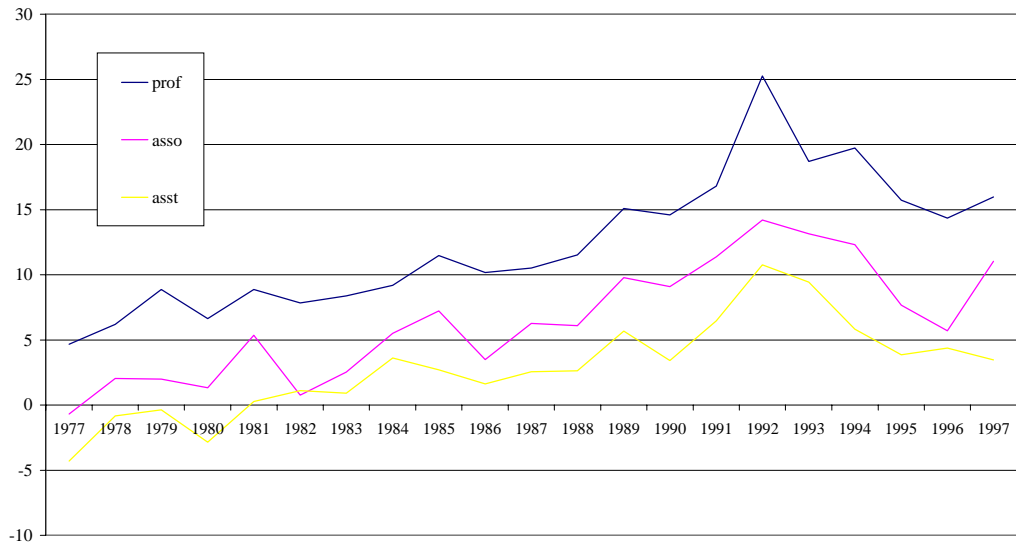


Figure 2: The evolution of the wage gap between private and public universities



At first sight, our data confirm the first prediction of tournament theory: 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%. This appears to indicate that the wage gap is increasing with the job level.

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

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

As we also have data on departments in both public (70 to 80%) and private (20 to 30%) universities, we can bring further evidence on the well known widening gap between public and private universities (see e.g. Alexander, 2001 and The Economist, 2000). Figure 3 shows the evolution of the gap between private and public departments for the different level. Private universities do pay better, especially at the level of the professors. However, the difference for assistant professors is fairly small. Note also that for all three job levels, the difference has increased over time³.

Tournaments take place in the context of an internal labor market with no explicit role for outside options. We check whether this important hypothesis is valid in economic departments. 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 newly hired individuals by year and by rank, and the percentage

³A problem so far has been that our sample is changing over time. To see whether things would change if we had complete panel, we also looked at the 52 universities for which we have observations both at the beginning and at the end of our period. We basically get the same results.

of newly hired individuals coming from outside the department by year and by rank. Table 2 shows the average of these three variables.

Table 2: Average Internal and Outside Mobility

Rank	% of individuals leaving the department	% of individuals hired by rank	% of new hired from the outside
Professors	3.6 %	5.5 %	28 %
Associates	3 %	12.1 %	25 %
Assistants	1.5 %	19.1 %	95.8 %

The average percentage of individuals leaving the department is relatively small and increasing with ranks, while the average percentage of individuals who are new in the department is decreasing with rank, and relatively large at the assistant professor level, which, in the case of the academic labor market, can clearly be described as a port of entry, as 95% of the new assistant professors are hired from the outside, while this percentage decreases dramatically with rank. These statistics are consistent with the idea of internal competition for jobs.

3.2 Individual Data

We further use information about the entire population of individuals related to 107 universities which were ranked by the NRC in 1993⁴. This dataset contains 2,673 individuals and provides the name, rank and university to 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 co-authorship).

The department composition, together with the bibliographic record of each individual, was then matched with the wage dataset. Wages for each

⁴As 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.

layer were available for 50 universities (the list is available from the authors), 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 tournament prize (the wage gap) is increasing along the promotion ladder. We regress the log of average wage over a dummy for associate, a dummy for full professor and some controls.

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

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 are a dummy for private universities and the size of the university (measured by the number of degrees awarded, in hundreds), the latest being less well reported. Results are presented in table 3.

Table 3: Wages and Ranks

Dep.var.: $\log W$	coeff (s.e.)	
<i>ASSO</i>	0.20*** (0.005)	0.20*** (0.004)
<i>PROF</i>	0.49*** (0.005)	0.49*** (0.004)
Nr.BA	-	0.07*** (0.004)
<i>PRIV</i>	-	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. This finding supports one implication from tournament theory that the gap between each layer of the hierarchy should become larger and larger, so as to provide incentives to tournament participants to exert effort and win the prize. Size of the institution and its ownership also play an important role in wage determination.

However, one could argue that wage differentials simply reflect productivity differentials. To control for this possibility, 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 1992 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 and 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 this yielded comparable results.

We link the cross section information on the composition of economic 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 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 individuals⁵ as the survey was not continued in subsequent years.

⁵In Coupé et al. (2003), we follow the career of a sample of 1,000 top economists

Wage gaps could reflect differences in average past publications. Universities are likely to reward individuals on the basis of past accomplishments, reflecting their reputation which increases the prestige of the university to which they are associated. We create a variable called average past publication by rank (*PPUB*) by summing all papers produced by the individuals in our sample over the period 1969-1992 over ranks and dividing by the number of individuals by rank. We regress the log of wage gaps over the log of *PPUB* for all ranks, controlling for ranks, as in Eq. (2):

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

Table 4: Wages and Past Performance

Dep.var.:	$\log W$
constant	10.57*** (0.03)
$\log PPUB$	0.08*** (0.02)
<i>ASSO</i>	0.08** (0.03)
<i>PROF</i>	0.38*** (0.04)
Nr.Obs	150
Adj. R ²	0.79

Note: see table 3

In 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 in size, we still find increasing wage gaps.

We also ran the equation for each rank separately:

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

and linked their productivity to their career achievements, but without information about individual wages.

Table 5: wage and past performance (by type of job)

Dep.var.:	$\log W_{\text{prof}}$	$\log W_{\text{ASSO}}$	$\log W_{\text{ASST}}$
constant	10.37*** (0.14)	10.61*** (0.1)	10.79*** (0.02)
$\log PPUB$	0.27*** (0.04)	0.13*** (0.03)	0.02 (0.015)
Nr.Obs	50	50	50
Adj. R ²	0.50	0.22	0.01

Note: see table 3

Table 5 presents 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 relates to the stylized fact that the variance of wages was more important for higher ranks.

One way to control for university fixed effects in the salary level would be to regress the difference of the log wages over the difference of the log past publications. Indeed, if

$$\begin{aligned}\log W_{j,\text{PROF}} &= \alpha_0 + \alpha_1 \log PPUB_{j,\text{PROF}} + \nu_j + \xi_{\text{PROF}} \\ \log W_{j,\text{ASSO}} &= \alpha'_0 + \alpha'_1 \log PPUB_{j,\text{ASSO}} + \nu_j + \xi_{\text{ASSO}} \\ \log W_{j,\text{ASST}} &= \alpha''_0 + \alpha''_1 \log PPUB_{j,\text{ASST}} + \nu_j + \xi_{\text{ASST}}\end{aligned}$$

where $\varepsilon_{jr} = \nu_j + \xi_{jr}$, ν_j is university fixed effect and $\xi_{jr} \sim N(0, \sigma_{jr})$. Then, by regressing instead

$$\log W_{j,\text{PROF}} - \log W_{j,\text{ASSO}} = \beta_0 + \beta_1 (\log PPUB_{j,\text{PROF}} - \log PPUB_{j,\text{ASSO}}) + \varepsilon_{\text{P-A}} \quad (4)$$

and similarly

$$\log W_{j,\text{ASSO}} - \log W_{j,\text{ASST}} = \beta'_0 + \beta'_1 (\log PPUB_{j,\text{ASSO}} - \log PPUB_{j,\text{ASST}}) + \varepsilon_{\text{A-A}} \quad (5)$$

we get rid of the university fixed effect. Results are presented in table 6.

Table 6: Wage Gaps and Past Publication Differences

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

Note: see table 3

We find a positive effect of publication: higher wage gaps are partly explained by higher 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. What we do not control for in this specification is that there could be a university-by-rank fixed effects. To properly address this issue, we would have needed a panel dataset.

A related alternative explanation for wage gaps is experience. Individuals would accumulate human capital and wages would be linked to seniority. Changes in experience could also have an influence on the evolution of the wage gap. 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. Controlling for the average experience level, we did not find significant effect of experience⁶.

To sum up, economic 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 sorting, as wages become more performance related at higher ranks.

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

⁶There 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, relatively to other contestants, universities are less likely to provide incentives in this area. A more pragmatic reason for ignoring it was that the data was not available.

are participants, the more complicated 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 over the number of associate professors waiting for promotion, controlling for size and type of institution.

$$\log GAP_{j, \text{PROF-ASSO}} = f(NR.ASSO_j, PRIV_j, SIZE_j) \quad (6)$$

and 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 as in the previous regression.

$$\log GAP_{j, \text{ASSO-ASST}} = f(NR.ASST_j, PRIV_j, SIZE_j) \quad (7)$$

Results are provided in table 7a. 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 ($GAP_{\text{ASSO-ASST}}$).

Table 7a: Effect of the (absolute) number of contestants on the wage gap

Dep.var.:	$\log GAP_{\text{PROF-ASSO}}$	$\log GAP_{\text{ASSO-ASST}}$
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

In our analysis, we have used 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) as a proxy for the chance of winning the prize. 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%.

One rough proxy 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. We create a variable labelled relative number of contestants by dividing the number of associate professors by the number of professors and the number of assistants by the number of associate professors. We then regress the wage gap over this new variable and controls. The results are presented in table 7b.

Table 7b: Effect of the (relative) number of contestants on the wage gap

Dep.var.:	$\log GAP_{\text{PROF-ASSO}}$	$\log GAP_{\text{ASSO-ASST}}$
Rel. Nr. Contestants	-0.016** (0.007)	0.015* (0.009)
Nr.BA	0.18*** (0.012)	0.14*** (0.014)
PRIV	0.30*** (0.027)	0.23*** (0.032)
constant	9.40*** (0.05)	8.92*** (0.06)
Nr.Obs.	1853	1852
Adj. R ²	0.18	0.09

Note: see table 3

We find a positive and slightly significant effect of the number of assistant professors per associate professor and a negative and significant effect of the number of associate professors per professor. This goes against our expectations and is much less supporting tournaments, but this might be because we use a rough proxy.

Ultimately, what we want to proxy is what is the probability to get tenure. Ehrenberg et al (1998) look at the effect of the probability of getting tenure on the wage differential between assistant and associate professors. They find a negative (so a higher probability of winning the prize decreases the size of the prize) but insignificant effect of the tenure probability on the ratio of the salary of an associate professor over the salary of an assistant professor. Using instrumental variables, they find a substantial significant effect: lowering the probability of getting tenure by 50% increases the ratio by 30 percentage points.

Again, we want to control for productivity differential. To do so, we first regress the log of the wage gap over the log of the gap in average cumulative

publications (see Eq. 4 and 5). The part which is not explained by the publication differential is the corrected wage gap (*CGAP*). We then regress the corrected wage gap over the number of (absolute and relative) contestants.

$$CGAP_{j,PROF-ASSO} = f(NR.CONTESTANTS_j) \quad (8)$$

$$CGAP_{j,ASSO-ASST} = f(NR.CONTESTANTS_j) \quad (9)$$

Results are reported in tables 8a and 8b. We observe that the number of contestants is relevant to explain the corrected gap only for assistant professors but not for associate professors.

Table 8a: The effect of the number of (absolute) 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

Table 8b: The effect of the number of (relative) contestants on the corrected wage gap

Dep.var.:	$CGAP_{PROF-ASSO}$	$CGAP_{ASSO-ASST}$
Nr. Contestants	-0.05 (0.03)	0.02*** (0.007)
constant	0.31*** (0.02)	0.12*** (0.01)
Nr.Obs.	50	50
Adj. R ²	0.02	0.12

Note: see table 3

The result can be linked to the observed hierarchical structure of economic 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.

4.3 Incentive Effect

Do economists at the assistant and associate level produce more in higher gaps universities? 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 (weighed for coauthorship and adjusted for quality, as for past publications) during the the years 1993-1995 as a measure of performance ($PERF$).

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

$$PERF_i = \lambda_0 + \lambda_1 GAP_{j,r} + \lambda_2 ASSO + \varepsilon_i \quad (10)$$

where $GAP_{j,r}$ 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 9). 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. This comparison only reflects cross-sectionnal differences between individuals in the subsamples, and not necessarily a dynamic reduction of productivity after the first promotion (on the latest see Coupé et al., 2003).

Table 9: Effect of the the wage gap on performance

Dep.var.:	$PERF$
GAP	5.35** (2.15)
ASSO	-2.37*** (0.55)
constant	4.95*** (0.53)
Nr.Obs.	597
Adj. R ²	0.03

Note: see table 3

Previously we noticed that part of the wage gap was due not to incentives reasons but to productivity differential. To correct for this, we use once again the corrected wage gap instead of the observed wage gap:

$$PERF_i = \lambda'_0 + \lambda'_1 CGAP_{j,r} + \lambda'_2 ASSO_i + \varepsilon'_i \quad (11)$$

Table 10: Effect of the corrected wage gap on performance

Dep.var.:	<i>PERF</i>
<i>CGAP</i>	7.83*** (2.31)
ASSO	-1.46*** (0.45)
constant	5.95*** (0.32)
Nr.Obs.	597
Adj. R ²	0.04

Note: see table 3

Results are presented in table 10. 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.

4.4 Cooperation

A disadvantage of tournament incentives is that they will decrease the willingness to cooperate with colleagues of the same rank. 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 coauthored papers by the total number of papers over the same period. To provide a snapshot of how cooperative behavior depends on rank, average internal cooperation within rank and cooperation are presented in table 11.

Table 11: cooperation and rank

	<i>COOP</i>	<i>ICWR</i>
Assistant	0.57	0.06
Associate	0.71	0.04
Professor	0.64	0.09

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, note that the the number of associate professors is often smaller than the number of assistant professors and much smaller than the number of professors.

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 that 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:

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

$$DICWR_i = 1 \text{ if } ICWR_i^* > 0$$

$$DICWR_i = 0 \text{ if } ICWR_i^* \leq 0$$

Table 12: Effect of the the wage gap on cooperation

Dep.var.:	<i>DICWR</i>
<i>GAP</i>	-0.078 (0.129)
<i>ASSO</i>	-0.052* (0.03)
Nr.Obs.	597
Pseudo R ²	0.02
Log likelihood	-204.4

Note: see table 3

Table 12 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 regress $ICWR$ on the corrected wage gap:

$$ICWR_i = \mu'_0 + \mu'_1 CGAP_{j_r} + \mu'_2 ASSO_i + \varepsilon_i$$

Table 13: Effect of the the corrected wage gap on cooperation

Dep.var.:	$ICWR$
$CGAP$	0.146 (0.136)
$ASSO$	-0.059** (0.025)
Nr.Obs.	597
Adj. R^2	0.02
Log likelihood	-204

Note: see table 3

Table 13 shows that the same conclusions prevail: the wage gap does not affect significantly cooperation within rank and associate professors appear to cooperate less internally within rank.

We also added the number of colleagues by rank as an additional control but results were unchanged. However, when we considered the subsample of 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.

4.5 Tournaments or Standards?

As shown in the theoretical framework, tournaments as well as standards should be associated with increasing wage gaps and a positive incentive effect of the wage gap on the productivity of individuals. We find some evidence in favor of these two predictions. However, standards can be distinguished from tournaments by the fact that the wage gap should not be linked to the number of contestants and should not have any effect on cooperation. Our findings go in this direction. So economic departments appear to use standards rather than tournaments. An additional way, suggested by Gibbs (1995), to discriminate between these two theories is to examine the extent to which job slots are fixed. 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.

5 Conclusion

We have used a very rich panel dataset providing average wage and department size at each level of the economic departments' hierarchy over more than twenty years to test empirically key elements of tournament theory. We provide evidence that wage gaps are increasing with the job level, even when controlling for differences in productivity by rank. Moreover, 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. We find that individual productivity is positively linked to wage gaps, i.e. wage gaps have an incentive effect. However, we do not find 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 the existence of standards rather than tournaments in economic departments. This is further confirmed by the variability of the organisational structure in economic departments.

References

- [1] Alexander, F.K. (2000), The Silent Crisis: The Fiscal Capacity of Public Universities to Compete for Faculty, Review of Higher Education, Forthcoming, December, 2000.
- [2] Baker, George P., Jensen, Michael C. and Murphy, Kevin J. (1988), Compensation and Incentives: Practice vs. Theory, Journal of Finance, 43, 593-616.
- [3] Bauwens, L. (1998), A New Method to Rank University Research and Researchers in Economics in Belgium, Working Paper, CORE.
- [4] Becker, Brian E. and Huselid, Mark A. (1992), The Incentive Effects of Tournament Compensation Systems, Administrative Science Quarterly, 37, 336-350.

- [5] Bognanno, Michael L. (2001), Corporate Tournaments, *Journal of Labor Economics*, 19, 290-315.
- [6] Conyon, Martin J., Peck, Simon I. and Sadler, Graham (1999), Corporate tournaments and executive compensation, mimeo, University of Warwick.
- [7] Coupé, Tom, Smeets, Valérie and Warzynski, Frédéric (2003), Incentives, Sorting and Productivity Along the Career, Mimeo, University of Toulouse.
- [8] Ehrenberg, Ronald G. and Bognanno, Michael L. (1990a), The Incentive Effects of Tournaments Revisited: Evidence from the European PGA Tour, *Industrial and Labor Relations Review*, 43, 74S-88S.
- [9] Ehrenberg, Ronald G. and Bognanno, Michael L. (1990b), Do Tournaments Have Incentive Effects?, *Journal of Political Economy*, 98, 1307-1324.
- [10] Ehrenberg, Ronald G., Pieper, Paul J. and Willis, Rachel A. (1998), Do Economics Departments with Lower Tenure Probabilities Pay Higher Faculty Salaries?, *Review of Economics and Statistics*, 80, 503-512.
- [11] Eriksson, Tor (1999), Executive Compensation and Tournament Theory: Empirical tests on Danish Data, *Journal of Labor Economics*, 17, 262-280.
- [12] Gibbs, Michael (1995), Testing Tournaments? An Appraisal of the Theory and Evidence, *Labor Law Journal*.
- [13] Lazear, Edward and Rosen, Sherwin (1981), Rank Order Tournaments as Optimal Labor Contracts, *Journal of Political Economy*, 89, 841-864.
- [14] Lazear, Edward (1989), Pay Equality and Industrial Politics, *Journal of Political Economy*, 97, 561-580.
- [15] McLaughlin, Kenneth J. (1988), Aspects of Tournament Models: A Survey, *Research in Labor Economics*, 9, 225-256.
- [16] Nalebuff, Barry J. and Stiglitz, Joseph E. (1983), Prizes and incentives: towards a general theory of compensation and competition, *Bell Journal of Economics*, 14, 21-43.

- [17] Prendergast, Canice (1999), The Provision of Incentives in Firms, *Journal of Economic Literature*, 37, 7-63.
- [18] Rosen, Sherwin (1986), Prizes and Incentives in Elimination Tournaments, *American Economic Review*, 76, 701-715.
- [19] Rosen, Sherwin (1988), Promotions, Elections and Other Contests, *Journal of Institutional and theoretical Economics*, 144, 73-90.
- [20] *The Economist* (2000), "University Education: The Gap Widens, 22/04/2000.