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ABSTRACT

What Matters Most: Teaching or Research? Empirical Evidence on the Remuneration of British Academics*

This Paper examines the impact of productivity on pay within academia, drawing upon a detailed dataset of academics from five old, established universities. We investigate the relationship between teaching and research skill but find no evidence in support of the hypothesis that productive researchers are also the best teachers. Our results outline the importance of publication, grant receipt and teaching skill in the determination of pay. We reveal a large financial penalty for time out of the profession, which, with productivity variables, explains away the gender salary gap. Results also suggest that the best academics stay within the profession.

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NON-TECHNICAL SUMMARY

This paper examines academic productivity and the impact of productivity on pay determination within the British academic profession. It aims to provide some visibility into the determinants of academic remuneration. We utilize a unique cross sectional dataset, which contains detailed information on salary and grading of the academic staff of five old, established universities. An important feature of the data is that it includes measures for individual teaching skill and research productivity. Such detailed data is not available in the existing literature in this area. In the first step of our analysis we use this data to analyse the relationship between research productivity and teaching skill in order to determine the complementarity between these attributes. The relationship between being a successful researcher and being a good teacher has been suggested to be important in the debate over whether teaching and research departments should develop separately within the UK. In the second stage of our analysis, we investigate the determinants of academic salary with a view to highlighting the skills currently most valued within the profession. Is it the case, for example, that teaching skills are highly rewarded, or is success purely determined by publication record? Finally, we address the quality of today's academic. This section investigates the determinants of academics' reservation salary with the aim of identifying those individuals most likely to leave the profession. Although the mobility of staff in and out of the academic sector might be beneficial to some extent, the profession should ensure its capability to retain the best and most productive individuals.

Of the 878 academics from whom information was collected, we select full-time academics who are paid on the non-clinical scale The part-time academics are deleted from our sample as we do not have good information on their working hours, which makes the comparison of their wages to the wages of full-time academics problematic. The academics paid on the clinical scale are dropped due to the difficulty of incorporating this additional, higher paid scale in our analysis. For our analysis we are left with 635 observations.

In the first part of our analysis we uncover no evidence of a positive relationship between being a successful researcher and a good teacher. Splitting the sample by rank reveals that results for staff in ranks lower than professor are very similar to those of the whole sample. We, therefore, conclude that there is no evidence against teaching and research departments developing separately within the UK, and some of our results would even promote it. In the second part of the analysis we model the academic wages by explicitly incorporating the 1994-5 salary scale structure. Our approach simultaneously explains salary and salary scale as a function of individual, job and productivity characteristics. The estimation results outline the importance of publication, grant receipt and teaching skill in attracting financial reward within the current payment system. We, therefore, provide some evidence to

ease concerns that the current reward system does not adequately recognize individual productivity. Perhaps surprising in this respect is the importance of teaching skills, which are revealed to have a sizeable impact on pay in our simulations. Also the probability of getting a professorship is affected substantially by teaching skill. Furthermore we find evidence for a negative reward to time out-of-labour-force (where we additionally control for experience and tenure, which do not include the time out-of-labour-force). So career breaks carry an associated penalty, perhaps due to depreciation effects as subject specific skills and knowledge becoming obsolete. Simulations show that this effect is sizeable – the salary loss associated with a one-year out-of-labour-force spell would require compensation equivalent to four to five additional refereed papers. Not only are women more likely to have had an out-of-the-labour-force spell, but if they have had such a spell the duration is also longer. On one hand our results are in contrast to most of the earlier literature on the gender wage-gap in the academic labour market, since controlling for time out-of-labour-force and individual productivity makes the gender-dummy insignificant at conventional significance levels. On the other hand the sizeable impact of the time out-of-labour-force clearly hints at gender-related problems. In the last part of our analysis we address the quality of today's academics, and we find some evidence of the (self-) selection of academics on the basis of their productivity. Results, therefore, suggest that the best academics, at least below the grade of professor, will stay within the profession.

1. Introduction

The Hay report (1997) revealed that over the ten-year period 1987-1996 university pay dropped a staggering 20% in real terms, falling behind the remuneration levels of comparable professions in the public sector. Dearing (1997) confirmed this trend, advising that although academic remuneration should be sufficient to recruit, retain and motivate staff of the required quality, the majority of staff in British higher education were in fact paid substantially below comparable private and public sector rates. Although one could argue that academics are interested in more than mere pecuniary reward[1], long-term underpayment may spark the drain of high quality individuals from academia into more lucrative positions in the private sector, or to academic positions abroad, and prompt concerns over the quality of staff left within the profession. Strikes by academics over pay during 1996 and 1999 were suggestive of a profession on the edge of their salary threshold.

Within the context of the academic underpayment debate, the adequacy of the remuneration structure currently in place has been challenged. Establishment level academic salaries, at least below professorial grades, remain formally set through a nationally negotiated fixed salary structure agreed between the Association of University Teachers (AUT) and the University and College's Employers Association (UCEA). Within this formal framework, staff progression is largely automatic and dependent on years of work. With the emergence of the research and teaching assessment exercises, however, and the dramatic increase in student numbers over recent years, individual productivity within the academic job, in particular that measured through publication record and administrative responsibility, has been emphasised, with teaching skill holding a less well-defined position. It is unclear, whether the current reward

[1] Academics have after all undertaken periods of extended study relative to the general labour force at an opportunity cost of perhaps considerable foregone earnings. For further discussion of non pecuniary reward see Ward and Sloane (1999).

system adequately recognises these facets of individual productivity and to what extent each are individually rewarded.

This paper examines academic productivity, the impact of productivity on pay determination within the British academic profession and aims to provide some visibility into the determinants of academic remuneration. We utilise a unique cross sectional dataset, which contains detailed information on salary and grade of the academic staff of five old established universities. An important feature of the data is that it includes measures for individual teaching skill and research productivity. Such detailed data is not available in the existing literature in this area. In the first step of our analysis we use this data to analyse the relationship between research productivity and teaching skill in order to determine the complementarily between these attributes. The relationship between being a successful researcher and a good teacher has been suggested to be important in the debate over whether teaching and research departments should develop separately within the UK. In the second stage of our analysis, we investigate the determinants of academic salary with a view to highlighting the skills currently most valued within the profession. Is it the case, for example, that teaching skills are highly rewarded, or is success purely determined by publication record? Finally, we address the quality of today's academic. This section investigates the determinants of academics' reservation salary with the aim of identifying those individuals most likely to leave the profession. Although the mobility of staff in and out of the academic sector might be beneficial to some extent, the profession should ensure its capability to retain the best and most productive individuals.

The remainder of the paper is structured as follows: Section 2 summarizes previous literature relevant to our analysis and section 3 outlines the main characteristics of our dataset. Section 4 analyses the relationship between teaching skill and research productivity. Sections 5 introduces our model, which incorporates the fixed UK framework of salary scales, for the

analysis of the determinants of academic salary in section 6. Section 7 considers a model of reservation salary. Section 8 concludes.

2. Previous literature

Until recently, there had been virtually no work written on pay within the British academic profession. The lack of detailed data on academics in the UK provides a hurdle for potential researchers. National statistics, collected by the Universities Statistical Record and the Higher Educational Statistics Agency, contain only very limited information. The census of academic salaries collected data on gender, age, date of recruitment, rank, faculty and salary, but ceased in 1993. McNabb and Wass (1997) use the census of academic salaries to consider the gender salary gap in academia in 1975, 1985 and 1992. They conclude that women are less successful in achieving promotions from the lecturer scale than their male counterparts, and receive lower remuneration. Their data, however, lacks variables on individual research productivity. More recently, papers by Blackaby and Frank (2000), Booth and Burton (2000) and Machin and Oswald (2000) have analysed the state of academic economics in the UK. Blackaby and Frank (2000) examine the representation of ethnic minorities. Their analysis, which includes detailed publication information, reveals no significant ethnic minority effect on academic rank, but a significantly negative earnings effect. Booth and Burton (2000) report on the position of women within the profession. Their findings suggest benefits of working in a standard academic post, rather than within a research only environment, to female academic success. Machin and Oswald (2000) investigate why so few British students currently pursue economics to PhD level. Evidence overwhelmingly suggests that low pay in academia, in comparison to the salaries available in the private sector, is the main explanation for this trend. Their paper raises fears over the future quality of the profession should pay related conditions not improve.

In contrast, the US literature on academic pay, where salary is not determined by a formal pay framework, is extensive, with the main emphasis lying in the investigation of the gender salary gap. Work on the wage tenure profile in academia has been undertaken by Ransom (1993), Brown and Woodbury (1995) and Hallock (1995) who provide some evidence of a negative return to tenure. Ransom (1993) claims that the negative return to tenure is induced by the monopsony power of universities. Johnson and Stafford (1974) and McDowell (1982) consider the effect of career interruption on salary and reveal evidence of negative effects to career breaks within some subjects. US research, however, also generally suffers from the lack of detailed productivity variables. One notable exception is the work by Tuckman, Gapinski and Hagemann (1977) who use cross sectional data from 1972-73 to consider reward to teaching ability, research productivity, public service and administrative skill. They find that research productivity is the most rewarded component of academic's ability, followed by administrative skill. Teaching ability and public service receive small and negligible reward respectively.

3. **Data**

The data used in this paper come from a cross section study of five old established universities: Aberdeen, Dundee, Glasgow, Heriot-Watt and St. Andrews undertaken in 1995/6. The data incorporates detailed information on the personal background, working history and productivity of 878 academics, collected by means of postal questionnaires.[2] Academic staff includes professors, senior lecturers and readers, lecturers and research assistants. The over-whelming advantage of this dataset is its uniqueness and detail. It includes, for example, detailed measures of individual teaching skill and research productivity, which allows us to undertake the first detailed analysis of salary within the UK academic profession. Its comparative disadvantage is

[2] The average response rate achieved was 30%, reasonably high for this type of study. Data were weighted for non-response at a faculty level by sex allowing for non-response at the level of rank by sex.

its' cross sectional nature. We are only able to analyse a snap-shot of the academic profession at one point in time without the ability to correct for selection in and out of the profession. This restriction is an important caveat to our analysis. Nevertheless the analysis of the cross sectional picture introduces some interesting propositions, to be challenged by future research.

Of the 878 academics from whom information was collected, we select fulltime academics (dropping 48 who work part time), those paid on the non-clinical scale (dropping 51 paid on the clinical scale) and those academics who are under the age of 64 (dropping 3 individuals). The part-time academics are deleted from our sample as we do not have good information on their working hours, which makes the comparison of their wages to the wages of fulltime academics problematic. The academics paid on the clinical scale are dropped due to the difficulty of incorporating this additional, higher paid, scale in our analysis. From our original sample we also loose 106 observations due to incomplete data and another 35 observations due to intractability of spinal salary point. We are therefore left with 635 observations.

The dataset contains information on an individual's actual and reservation salary. Actual salary is defined as a respondents's response to the question 'What is your annual salary, that is before any deductions for tax, national insurance, pension contributions, union dues and so on?'. Staff are asked to report this annual salary together with the payment scale of this remuneration. Actual salary therefore refers to pay received on the university payment scale only, that is, it makes unlikely any additional salary attracted from consultancy etc. Reservation salary is questioned though 'What is the lowest salary that you would accept in order to move jobs?'. This question attempts to capture the minimum incentive required for academic mobility, whether it be mobility to another job within the academic profession, or outside.

The definitions of the variables used in our analysis are given in Table 1. Variables include individual and job characteristics, information on job position, university, faculty, publication and other productivity variables such as teaching skill and grant receipt. Table 2

presents summary statistics for our sample. The first column in table 2 gives the summary statistics for the full sample of 635 observations.[3] We see that the majority of academics are male and are UK citizens. Academics hold on average around 17 years of experience, nearly 10 years of which have been spent with their current university. Over 70% of academics hold a PhD and about 31% are researchers, 34% are lecturers, 21% are senior lecturers or readers and 14% are professors. The science faculty is largest in terms of its staff numbers within the five universities – nearly 40% of academic staff work here and Dundee and Glasgow are the largest universities, employing 26% and 32% of our academics respectively. About one out of five respondents are evaluated by their students as a skilled teacher.

Table 2 also presents mean statistics for research productivity. The average number of publications for our sample of academics is 20 refereed papers and one book. As research traditions vary substantially by scientific field, table 3 presents these statistics broken down by the faculty that the respondent is working in. The table shows that in the Arts and Social Sciences it is relatively common to write books or chapters in books. On the other hand, the number of published papers is on average substantially higher in Science. The average number of grants awarded is higher for the science and medical faculties. In the following analysis we take the differences between scientific fields into account by including the number of books, chapters in books, refereed papers, and grants, divided by their averages of the field in which the respondent is working, as explanatory variables. Table 3 also presents statistics suggestive of a positive relationship between teaching skill and research productivity. Those academics with teaching skills have also published more books, chapters in books, and refereed articles, and received more grants on average than those without. There is some indication of a cohort effect here however, with skilled teachers being on average older than unskilled.

[3] Descriptive statistics for the complete dataset can be found in Ward (1999).

Table 4 presents the average actual and reservation salary statistics for academics by rank. On average, staff report a reservation salary greater than that they actually receive. Academics would therefore expect a salary premium over their current job in order to excercise mobility to another job. There is an interesting group of 175 academics, however, with a low reservation salary. That is, individuals who would accept a salary less or equal to their current salary in order to move jobs. We might characterize these workers as the most likely to excercise mobility to a new job. Comparison of the majority, or high reservation salary academics, and this low reservation group, reveals that individuals with a low reservation salary are younger, are more likely to be female, in the lower rungs of an academic career and on a short-term contract (comparison of colomns 2 and 3 in table 2) than the group of high reservation salary academics. Booth and Burton (2000) find that female economists at the grade of lecturer are much more likely to leave a department at the lecturer level and that this mobility was most likely to be to a position outside academia, rather than to another academic job.

4. **Are good researchers also good teachers?**

In the first step of our analysis of academic productivity we investigate further the hypothesis that productive researchers are also the best teachers. The relationship between being a successful researcher and a good teacher has been suggested to be important in the debate over whether teaching and research departments should develop separately within the UK. Evaluation of academic quality on the basis of publication record, promoted by the commencement of the research assessment excercise, often implicitally assumes that experienced researchers hold the best credentials for sucessful teaching. We run a probit regression of teaching skill against individual, job and research productivity characteristics to test this relationship. Results are presented in table 5. The first column, for the full sample of our academics, suggests no strong support for our hypothesis. Experience is revealed to have a significantly positive effect on the

probability of being a skilled teacher, and we find some differences in teaching skill by faculty. Of the reseach productivity variables included in analysis however, only the number of chapters has a positive and significant effect on the probability of being a skilled teacher. All other variables are insignificant. Splitting the sample by rank to take further account of the possible cohort effect in teaching skill suggested by the statistics of table 3 reveals that results for staff in ranks lower than professor are very similar to those of the whole sample (see colomns 2 and 3 in table 5). Results for professor only, however, actually suggest a significanlty **negative** relationship between the number of refereed articles published and teaching skill.

5. Econometric Model

In the U.K. academic sector, all academic and research staff up to professorial level are paid according to a nationally agreed pay scale. Figure 1 presents the 1994/1995 salary scale.[4] Academics are placed onto a particular spinal point within a specific scale, such as Lecturer A, by their university and then rise automatically up the rungs or points of a scale, one point each year, until the maximum for that scale is reached. An academic will seek promotion from one grade to the next. Accelerated progression up the points of a scale or through the grades and additional salary payments in the form of discretionary awards are possible. There exists however a minimum point at spinal point 4 for those staff with a PhD and a minimum point for individuals aged 27 at spinal point 6. This framework allows us to calculate a minimum spinal point for each academic, on the basis of age, tenure and time out of the labour force. For instance, an academic at age 29 with a tenure of 2 years has to be at least in spinal point 8.

The traditional approach is to apply linear regression to a wage equation. However, this approach ignores the data we have on academic positions, and ignores the fact that salaries are

not contineously distributed. In order to take account of these problems, we explicitly model the UK academic system of salary scales[5]. We model the spinal points and salary scales as an ordered probit. x_i is defined as a vector of explanatory variables, β as a parameter vector, and ε_i^s as an individual disturbance term. The minimum spinal point on which an academic can be paid is represented by the point m and the threshold value T^m, which is determined by age, tenure and the time out of the labour market.

$$(1a) \quad s_i^* = x_i'\beta + \varepsilon_i^s$$

$$s_i = j \quad \text{if } T^m \leq T^j < s_i^* \leq T^{j+1}$$

$$= m \quad \text{if } s_i^* < T^m$$

Next we define w_i as the natural logarithm of the salary of individual i. We model salary according to the salary scales of figure 1 with salary w^j for the spinal points j from 4 to 27, with ε_i a individual disturbance term, and $I(s_i = j)$ an indicator function for being on spinal point j.

$$(1b) \quad w_i = \Sigma_{j=4,..,27} \; w^j \, I(s_i = j) + \varepsilon_i$$

Due to the fact that our information on spinal points is imperfect - for most respondents we only observe the salary scale, not the spinal point (see appendix A), - the reported salaries contain additional information to estimate the model. In the case that we knew the exact spinal point for all respondents, equation (1b) would only identify the variance of the error term ε_i – which could be interpreted as measurement error.

[4] For a part of our sample the 1994/1995 scale is relevant scale, while for another part the 1995/1996 scale is the relevant scale. Compared to 1994/1995 scale, the salaries of the 1995/1996 scale were increased by 2.7 percent. This fact is taken into account in our analysis.

Professors are not paid according to a salary scale, and therefore we model their salaries separately. As there is a minimum wage for professors, we use a censored regression model, with z_i as a vector of explanatory variables, γ as a parameter vector, and ε_i^* as a disturbance term.

$$
\begin{aligned}
(1c) \quad w_i^* &= z_i'\gamma + \varepsilon_i^* \\
w_i^p &= w_i^* \qquad \text{if } w_i^* > w_i^m \\
&= w_i^m \qquad \text{if } w_i^m \geq w_i^*
\end{aligned}
$$

The data on professors' salaries does not add information to the model of the spinal points, but since it is interesting in itself, we include it in our model. For estimation we assume the disturbance terms $(\varepsilon_i^s, \varepsilon_i, \varepsilon_i^*)$ to be independent of the explanatory variables (x_i, z_i) and to be identically and independently trivariate normally distributed. Our model can be interpreted as an extended version of the switching regression or the Tobit Type 5 model, see Amemiya (1984), in which the switching part of the model is replaced by an ordered probit. As from the data it is not clear whether the restrictions on the scales and the professional salaries hold in practice (see appendix A), we estimate one model without restrictions, and one model with restrictions, although the results of both models turn out to be very similar.

6. Academic salary

One of the aims of our analysis is to provide some visibility into the impact of productivity on pay. In this section we analyse the determinants of academic salary using the model described in section 5 and the same set of explanatory variables capturing individual, job and research productivity characteristics as used in section 4. Table 6 displays the estimation results.

[5] See Appendix A for further details, including the likelihood function, for this model. Still as a comparison, we report and discuss wage regression results in appendix C.

The model reveals some interesting results. First, we find evidence for the deregulation of established pay and promotion structures; in Heriot-Watt University and in the social sciences, academics are put on significantly higher spinal points. This is in line with McNabb and Wass (1997), although contrary to their results we find no significant difference in rewards to full time academics across gender. Second, progression along spinal points is driven mainly by individual productivity variables. We reveal a positive reward to experience, number of books published, number of refereed papers published, number of grants awarded ***and*** high teaching ability[6]. Third, we find evidence of negative effects to career breaks, possibly due to the depreciation effects of career breaks as subject specific skills and knowledge become obsolete.

Our results are in contrast to most of the earlier literature on the gender wage-gap in the academic labour market, since the gender-dummy is not significant at conventional significance levels. The reason for this contrasting result might be the fact that we are able to correct for productivity. Excluding the productivity variables (books, chapters, papers, grants, having PhD, and teaching skills) from our analysis reveals a significant gender wage-gap at a 10 percent significance level (see column 2 in table B.1 in appendix). Also interesting in this respect is the variable 'Time-out' which measures the length of periods out of the labour force. Not only are women more likely to have had an out-of-labour-force spell (in our sample 40 percent of women against 10 percent of men), if they have had such a spell the duration is also longer (in our sample 2.5 years on average for women against 1.5 years on average for men). Including an interaction term between gender and the 'Time-out' variable reveals that men are not 'punished' significantly differently for such spells to women. The variables experience and tenure do *not* include the out-of-labour-force time, so the results indicate that mothers, and also fathers, who decide to take maternity leave, for example, are disadvantaged in the academic labour market.

[6] We recognize that there might be some causal effect the other way around – from salary to productivity. None of the papers on this topic mentions this potential problem. And also with our data at hand we see no way to correct for

McDowell (1982) argues that durability of knowledge differs significantly by research field. We tested his hypothesis by interacting the 'Time-out' variable with the faculty variables[7]. We find however no significant differences between the fields of research, which might be due to the fact that the number of observations is small for such a detailed analysis.

Our model of professorial pay is interesting in that none of the explanatory variables included in the model are significant. At face value this result seems to suggest that once the position of professor has been attained, factors such as experience, publication record and teaching skills might not be so important to reward. Instead factors such as negotiation skill, the presence of outside salary offers and moving costs may be important determinants of professorial pay, which are not captured within our model. This result is in line with Baimbridge and Simpson (1996), who find very few significant variables in their model of the financial remuneration of vice chancellors and principals at UK higher institutions, and instead establish an idea of a 'going rate' for vice-chancellors.

Tables 6A and 6B present simulation exercises with respect to productivity and gender-related issues for two reference academics, using our model with restrictions. The aim of these excercises is to give an idea of the level and type of investment that would be required by an academic at an earlier stage of their career in order to achieve a given spinal point later on. As reference academics, we choose two academics in the social sciences; one academic with characteristics close to the average lecturer, and one academic with characteristics close to the average senior lecturer/reader. Tables 6A and 6B present the characteristics of these reference academics. Table 6A shows a lot of probability mass between spinal points 11 and 18, which most likely represents clustering at the top of the lecturer A and lecturer B scales as individuals wait for promotion to the next salary scale. We also find high mass in points 12, 13 and 20. In

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this endogeneity.

[7] Results for this analysis are not presented here, but are available on request.

table 6B the relevant high mass points are 18, 20, 24 and being a professor. The predicted salaries seem in line with what might be expected on the basis of the actual salaries in the data.

Although the variables on research productivity are highly significant in our model, the size of their impact turns out to be modest. An additional published book increases the expected wage by 0.7 to 0.8 percent, while an additional published paper increases the expected wage by 0.3 to 0.4 percent. Sensitivity analysis on the role of cohort effects in the reward to publication and other productivity variables (see table B.2) suggests a higher reward to the publication of refereed articles and grant receipt by younger academic staff (under the age of 40) than older academics.

A remarkable result is the impact of teaching skills on expected salary. Our simulation exercise reveals a reward to good teaching skills that equals the reward to between 12 and 15 refereed papers! For our second reference academic, changing from an unskilled to a skilled teacher increases the probability of being professor from 15.1 to 23.8 percent. Also worth noting is the effect time out of the labour force. A one-year spell decreases the expected salary by 1.3 to 1.8 percent; and would have to be compensated by 4 to 5 refereed papers. Although the gender-variable itself is not significant, our simulations show that the impact of gender-related issues are considerable. Changing our male reference academic without an out-of-labour-force spell into a woman with a one year out-of-labour-time spell decreases, *ceteris paribus*, the expected salary by 2.8 to 3.8 percent.

As a comparison to our results, we also run an OLS regression of salary against individual characteristics. The detailed results of this are discussed in appendix C. The main finding is that the overall conclusions from this exercise are very much in line with the results from our spinal point and salary scale model[8].

[8] The advantage of the model described in section 5 over OLS is that it allows us to incorporate the fixed framework of UK academic salary determination into our analysis, it allows us to include information on spinal points as well as salary scale into our measurement of salary, and that it allows us to undertake the detailed similation analysis described above.

7. Reservation salary

This section investigates the determinants of academics' reservation salary with the aim of identifying those individuals most likely to leave the profession. Although the mobility of staff in and out of the academic sector might be beneficial to some extent, one would hope that the profession is able to retain the best and most productive academics. Consideration of reservation data has become more usual in economics in recent years. For example, work using data on reservation wages exists in the job-search literature. The most well known of such studies is by Lancaster and Chesher (1983) who use respondent's reservation wages to deduce the structural parameters of the standard optimal job search model. We assume actual salary to be exogenous, and analyse the deviation of reservation from actual salary regressed on the same set of explanatory variables utilised in the previous two section. Results are presented in table 7.

We see that *ceteris paribus* the impact of salary on an individual's reservation salary is u-shaped with the minimum at the top of the Lecturer B scale with an annual salary of £26,230. Although not significant, experience is n-shaped with the maximum at 30.41 years of experience. The insignificant results on the productivity variables for the full sample in table 7 provide a neutral answer to our question concerning whether academia can retain its most productive staff. It appears that good academics are at least not setting low reservation wages for themselves in order to leave the profession. On the other hand, this is also true of the less productive academics. When our sample is split by rank however, we find significant effects on the number of refereed papers published for staff below the rank of professor, at least some evidence that academia can retain its most productive staff at these grades. A surprising result is the impact of the number of chapters and of teaching skill, which have a significantly negative impact for professors. A tentative explanation for these results might be that such forms of productivity are viewed by professors as under-valued in British academia.

6. Conclusion.

Our analysis of academic productivity and its impact on remuneration within the British academic profession has uncovered a number of interesting effects. First, we uncover no evidence for a positive relationship between being a successful researcher and a good teacher. We therefore present no evidence against teaching and research departments developing separately within the UK and some of our results would promote it. Second, our results outline the importance of publication, grant receipt and teaching skill in attracting financial reward within the current payment system. Our model therefore provides some evidence to ease concerns that the current reward system does not adequately recognise individual productivity. Perhaps surprising in this respect is the importance of teaching skills, which are revealed to have a sizeable impact on pay in our simulations. Third, we find some suggestion of a negative reward to time out of the profession - career breaks carry an associated penalty, perhaps due to depreciation effects as subject specific skills and knowledge become obsolete. Simulations show that this effect is sizable; the salary loss associated with a one-year out-of-labour-force spell would require compensation equivalent to 4 to 5 additional refereed papers. Not only are women more likely to have had an out-of-the-labour-force spell, but if they have had such a spell the duration is also longer. Our results are in contrast to most of the earlier literature on the gender wage-gap in the academic labour market, since controlling for time out and individual productivity, the gender-dummy is not significant at conventional significance levels. Finally, in addressing the quality of today's academic we find some evidence of the (self-)selection of academics on the basis of their productivity. Results therefore suggest that the best academics, at least below the grade of professor, will stay within the profession.

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TABLE 1

List of Variables

Name	Definition
Individual characteristics	
Male	= 1 if male, = 0 if female
UK Citizen	= 1 if UK citizen, = 0 otherwise
Job characteristics	
Experience	Length of total labour market experience, measured in years
Job tenure	Length of time with current employer, measured in years
Time-out	Length of time out of labour force, measured in years
Job position	
Researcher	= 1 if researcher, = 0 otherwise
Lecturer	= 1 if lecturer A or lecturer B, = 0 otherwise
Senior/reader	= 1 if senior lecturer or reader, = 0 otherwise
Professor	= 1 if professor, = 0 otherwise
University	Dummies for the five universities from which data was collected: Aberdeen, Glasgow, Dundee, St. Andrews, Heriot -Watt
Faculty	Dummies for the five faculties in which respondents work: Arts, Science, Engineering, Social Sciences, Medicine
Publications	
Books	Total number of books published
Chapters	Total number of chapters in books published
Papers	Total number of refereed publications published
Other	
Grants	Total number of grants received
Having PhD	= 1 if holds a PhD, = 0 otherwise
Teaching skill	= 1 if skilled teacher (based on student's evaluations), = 0 otherwise

TABLE 2

Sample Statistics

	Full sample (635 obs.)		High res.salary wr>wa (345 obs.)		Low res.salary wr<=wa (175 obs.)	
	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)
Individual characteristics						
Age under 30	0.213		0.206		0.303	
Age 30-39	0.312		0.322		0.367	
Age 40-49	0.265		0.267		0.240	
Age 50 and over	0.211		0.206		0.091	
Male	0.691		0.725		0.611	
UK Citizen	0.882		0.855		0.903	
Job characteristics						
Experience	16.731	(10.854)	16.633	(10.491)	13.243	(9.978)
Job tenure	9.700	(9.997)	9.723	(10.165)	6.864	(7.696)
Time-out	0.422	(1.646)	0.302	(1.186)	0.471	(1.457)
Short-term	0.361		0.310		0.571	
Job position						
Researcher	0.312		0.278		0.474	
Lecturer	0.340		0.345		0.326	
Senior/reader	0.205		0.212		0.114	
Professor	0.143		0.165		0.086	
University						
Aberdeen	0.162		0.171		0.120	
Dundee	0.260		0.258		0.263	
Heriot-watt	0.068		0.078		0.069	
St.Andrews	0.192		0.174		0.223	
Glasgow	0.318		0.319		0.326	
Faculty						
Arts	0.170		0.157		0.166	
Engineer	0.139		0.162		0.086	
Medicine	0.143		0.148		0.154	
Science	0.387		0.371		0.457	
Social sciences	0.161		0.162		0.137	
Publications						
Books	1.074	(2.418)	1.104	(2.554)	0.783	(2.122)
Chapters	2.805	(6.515)	2.571	(4.863)	1.800	(3.883)
Papers	20.109	(28.292)	21.183	(27.763)	14.720	(28.317)
Chapters						
Other						
Grants	4.951	(8.151)	5.157	(7.700)	3.589	(7.309)
Having PhD	0.728		0.710		0.709	
Teaching skill	0.198		0.194		0.149	

Note: wr = reservation wage: based on the answer to 'what is the lowest salary that you would accept in order to move jobs?', wa = actual wage: based on the answer to 'what is your annual salary that is before any deduction for tax, national insurance, pension contributions, union dues and so on?'. Standard deviation in parentheses.

TABLE 3

Research and Teaching Statistics by faculty

	Number of obs.	Age		Books		Chapters		Papers		Grants	
Faculty		mean	(s.d.)	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)
Arts	107	45.73	9.84	2.28	3.39	3.89	5.22	13.03	15.89	2.54	4.49
Engineer	88	39.00	10.49	0.28	0.80	2.05	10.90	16.68	24.26	4.48	6.57
Medicine	91	36.85	9.13	0.46	1.11	2.22	4.51	19.68	26.27	6.12	10.86
Science	246	39.42	10.50	0.60	1.38	2.13	5.06	26.50	34.58	6.13	9.39
Social Sciences	103	40.80	10.35	2.17	3.74	4.49	6.74	15.50	23.40	4.02	5.28
	Number of obs.	Age mean	(s.d.)	Books (weighted) mean	(s.d.)	Chapters (weighted) mean	(s.d.)	Papers (weighted) mean	(s.d.)	Grants (weighted) mean	(s.d.)
No teaching skills	509	39.25	10.66	0.86	1.98	0.73	1.64	0.91	1.34	0.88	1.45
Teaching skills	126	44.44	8.69	1.56	2.89	2.07	4.99	1.35	1.13	1.48	1.88

Note: Weighted by dividing the number of books (chapters, papers, grants) by the average number of books (chapters, papers, grants) of the facults in which the individual works.

TABLE 4

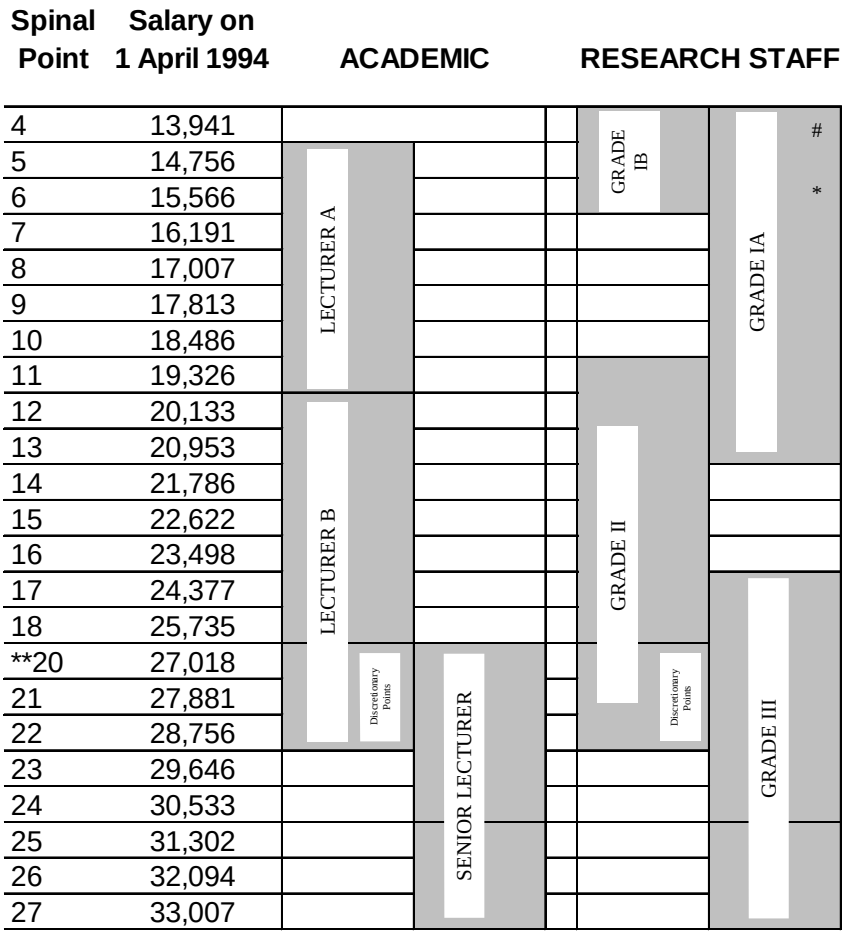
Salary Statistics by faculty

	Number of observations	Actual salary mean	(s.d.)	Reservation salary mean	(s.d.)
Researcher	148	17,690	(2,680)	18,420	(4,630)
Lecturer	151	22,790	(3,570)	26,100	(7,390)
Senior lecturer/reader	80	30,550	(1,940)	36,920	(9,630)
Professor	59	38,510	(4,150)	49,790	(20,160)

Figure 1

SALARY SCALES 1994/1995

Joint Negotiating Committee for Non-Clinical Academic and Academic Related Staff



Notes: * Age 27 point
Minimum appointment level for staff with PhD
** Point 19 was deleted with effect from 1.4.91

TABLE 5

Probit for Teaching Skill

Dependent variable	Teaching skill , = 1 if skilled teacher (based on student's evaluations), = 0 otherwise					
	Full sample		Excluding Professors		Professors only	
	parameter	(s.e.)	parameter	(s.e.)	parameter	(s.e.)
Number of Obs.	*635*		*544*		*91*	
Individual characteristics						
Intercept	-2.387	(0.340)	-2.668	(0.381)	-0.383	(0.618)
Male	0.048	(0.166)	0.151	(0.177)		
UK Citizen	-0.087	(0.209)	-0.202	(0.218)		
Job chararacteristics						
Experience	0.110	(0.031)	0.116	(0.036)		
Experience²/10	-0.029	(0.008)	-0.032	(0.010)		
Tenure	0.032	(0.027)	0.034	(0.032)	0.046	(0.061)
Tenure²/10	-0.001	(0.009)	-0.002	(0.010)	-0.010	(0.018)
Time-out	-0.090	(0.061)	-0.078	(0.062)		
University						
Aberdeen	-0.155	(0.186)	0.209	(0.213)	-1.301	(0.551)
Dundee	-0.158	(0.181)	-0.132	(0.201)	-0.296	(0.575)
Heriot-Watt	0.296	(0.250)	0.310	(0.294)	0.392	(0.565)
St.Andrews	0.118	(0.190)	0.320	(0.219)	-0.236	(0.498)
Faculty						
Arts	0.484	(0.186)	0.542	(0.211)	0.443	(0.517)
Engineer	0.158	(0.224)	0.354	(0.254)	-0.608	(0.616)
Medicine	0.403	(0.215)	0.687	(0.239)	-2.026	(4.480)
Social Sciences	0.756	(0.190)	1.009	(0.220)	0.260	(0.478)
Publications						
Books (weighted)	0.003	(0.031)	-0.034	(0.055)	0.046	(0.049)
Chapters (weighted)	0.076	(0.028)	0.114	(0.047)	0.016	(0.053)
Papers (weighted)	-0.080	(0.059)	0.041	(0.086)	-0.282	(0.116)
Other						
Grants (weighted)	0.034	(0.044)	-0.015	(0.058)	0.181	(0.105)
Having PhD	0.286	(0.163)	0.297	(0.187)	-0.271	(0.448)

TABLE 6

Estimation Results using Spinal Point and Salary Scale

	Model without Restrictions				Model with Restrictions			
Dependent variable	***Ordered response*** Spinal point par.	(s.e.)	***Linear Model*** Ln(salary prof) par.	(s.e.)	***Ordered response*** Spinal point par.	(s.e.)	***Linear model*** Ln(salary prof) par.	(s.e.)
Individual characteristics								
Intercept	0.4076	(0.3799)	10.5970	(0.1312)	-0.4523	(0.5174)	10.5917	(0.1085)
Male	0.1109	(0.1385)			0.1362	(0.1794)		
UK Citizen	0.1266	(0.1763)			0.2781	(0.2313)		
Job characteristics								
Experience	0.1929	(0.0271)			0.2405	(0.0345)		
Experience²/10	-0.0274	(0.0068)			-0.0358	(0.0081)		
Tenure	0.0201	(0.0268)	0.0036	(0.0058)	-0.0288	(0.0323)	0.0038	(0.0056)
Tenure²/10	-0.0054	(0.0086)	-0.0018	(0.0017)	0.0075	(0.0100)	-0.0018	(0.0017)
Time-out	-0.0952	(0.0351)			-0.1201	(0.0485)		
University								
Aberdeen	0.1704	(0.1768)	-0.0188	(0.0446)	0.1981	(0.2030)	-0.0194	(0.0437)
Dundee	0.0445	(0.1526)	-0.0044	(0.0575)	0.0899	(0.1962)	-0.0054	(0.0565)
Heriot-Watt	0.5524	(0.2579)	-0.0614	(0.0587)	0.6011	(0.2973)	-0.0607	(0.0574)
St.Andrews	-0.0655	(0.1709)	0.0612	(0.0460)	-0.0395	(0.2109)	0.0621	(0.0451)
Faculty								
Arts	0.1021	(0.1749)	-0.0102	(0.0487)	0.1064	(0.2052)	-0.0112	(0.0478)
Engineer	-0.2895	(0.1905)	0.0470	(0.0578)	-0.3974	(0.2423)	0.0502	(0.0567)
Medicine	-0.0207	(0.1904)	0.0768	(0.0613)	-0.0758	(0.2362)	0.0076	(0.0602)
Social Sciences	0.3611	(0.1859)	-0.0143	(0.0505)	0.3070	(0.2224)	-0.0131	(0.0485)
Publications								
Books (weighted)	0.1165	(0.0369)	-0.0060	(0.0059)	0.1223	0.0397	-0.0056	0.0059
Chapters (weighted)	-0.0216	(0.0254)	-0.0048	(0.0055)	-0.0240	0.0268	-0.0050	0.0054
Papers (weighted)	0.3614	(0.0747)	0.0009	(0.0114)	0.3933	0.0815	0.0008	0.0108
Other								
Grants (weighted)	0.1333	(0.0462)	0.0064	(0.0101)	0.1616	0.0502	0.0060	0.0100
Having PhD	0.2323	(0.1423)	-0.0434	(0.0441)	-0.0279	0.1788	-0.0390	0.0414
Teaching Skill	0.3229	(0.1527)	0.0384	(0.0359)	0.3208	0.1717	0.0374	0.0351
Distr. parameters								
standard dev.	0.0728	(0.0047)	0.0928	(0.0122)	0.0721	0.0047	0.0908	0.0116
correlation	-0.5043	(0.0717)	-0.0213	(0.5083)	-0.4487	0.0896	-0.2134	0.4729

TABLE 6A

Simulation

Reference academic 1 =	Male citizen, 36 years, 12 years experience, 4 years tenure, no time-out-of-labour-force 1 book, 2 chapters, 6 papers, 2 grants, PhD, no teaching skills								
Scale	ref.	+1 book	+1 chapt.	+1 paper	+1 grant	+ teach skill	+1 time out	woman	+1 time out and woman
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10	4.26%	3.99%	4.29%	4.14%	4.07%	2.85%	4.87%	4.95%	5.61%
11	13.89%	13.17%	13.95%	13.56%	13.38%	10.03%	15.44%	15.65%	17.24%
12	10.38%	10.00%	10.41%	10.21%	10.11%	8.18%	11.16%	11.27%	12.01%
13	15.85%	15.51%	15.88%	15.70%	15.61%	13.63%	16.50%	16.58%	17.12%
14	2.06%	2.03%	2.06%	2.05%	2.04%	1.88%	2.10%	2.10%	2.12%
15	7.44%	7.39%	7.44%	7.42%	7.41%	7.00%	7.49%	7.49%	7.48%
16	3.28%	3.28%	3.27%	3.28%	3.28%	3.19%	3.25%	3.25%	3.20%
17	7.62%	7.67%	7.61%	7.64%	7.66%	7.72%	7.45%	7.43%	7.21%
18	14.34%	14.67%	14.31%	14.50%	14.58%	15.89%	13.59%	13.48%	12.66%
20	10.10%	10.56%	10.06%	10.31%	10.43%	12.67%	9.13%	9.00%	8.07%
21	4.03%	4.29%	4.01%	4.15%	4.22%	5.62%	3.50%	3.44%	2.96%
22	1.45%	1.56%	1.44%	1.50%	1.53%	2.15%	1.23%	1.21%	1.02%
23	0.61%	0.66%	0.61%	0.63%	0.65%	0.93%	0.51%	0.50%	0.42%
24	3.21%	3.52%	3.18%	3.35%	3.43%	5.26%	2.63%	2.55%	2.07%
25	0.73%	0.81%	0.72%	0.77%	0.79%	1.35%	0.57%	0.55%	0.42%
26	0.20%	0.22%	0.19%	0.21%	0.21%	0.39%	0.15%	0.14%	0.11%
27	0.10%	0.11%	0.10%	0.11%	0.11%	0.20%	0.08%	0.07%	0.05%
Prof.	0.47%	0.54%	0.46%	0.50%	0.52%	1.06%	0.34%	0.33%	0.23%
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Expected Salary	23,260	23,420	23,250	23,330	23,370	24,210	22,950	22,910	22,620

Note: The first column of the table gives the probability of our reference academic, given his portfolio of characteristics, of being paid according to each spinal point of the salary scale. The second, third, fourth….etc column then gives the probability of finding our academic being paid on each of the spinal points of the salary scale, given that he changes his portfolio by one additional book, chapter in a book, paper, grant award, by acquiring teaching skill, by taking a 1 year career break, or by becoming a woman, or finally by taking a 1 year career break while being a woman. The final row of the table gives the reference academic's expected salary for each of the new portfolio scenarios. E.g the reference academic with his given portfolio has an expected salary of 23,260 GBP. Increasing his publication record by 1 refereed article would increase his salary to 23,330 GBP. Taking a break from the labour market for one year would decrease his expected salary to 22,950 GBP. If he had been female and had taken a one-year career break, his expected salary would have been 22,620 GBP.

TABLE 6B

Simulation

Male citizen, 48 years, 24 years experience, 16 years tenure, no time-out-of-labour-force, 2 books, 4 Reference academic 2 = chapters, 16 papers, 6 grants, PhD, no teaching skills

Scale	ref.	+1 book	+1 chapt.	+1 paper	+1 grant	+ teach skill	+1 time out	woman	+1 time out and women
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
11	1.17%	1.03%	1.19%	1.11%	1.07%	0.55%	1.52%	1.57%	2.01%
12	1.36%	1.22%	1.38%	1.29%	1.26%	0.69%	1.71%	1.76%	2.18%
13	3.25%	2.96%	3.28%	3.12%	3.04%	1.81%	3.95%	4.05%	4.85%
14	0.56%	0.52%	0.57%	0.54%	0.53%	0.33%	0.67%	0.69%	0.80%
15	2.39%	2.21%	2.41%	2.31%	2.26%	1.45%	2.82%	2.88%	3.33%
16	1.27%	1.18%	1.27%	1.22%	1.20%	0.80%	1.47%	1.50%	1.71%
17	3.60%	3.36%	3.62%	3.49%	3.43%	2.35%	4.11%	4.18%	4.71%
18	10.73%	10.20%	10.78%	10.49%	10.35%	7.70%	11.85%	12.00%	13.05%
20	14.28%	13.87%	14.32%	14.09%	13.99%	11.62%	15.05%	15.14%	15.72%
21	9.65%	9.54%	9.66%	9.60%	9.58%	8.69%	9.79%	9.80%	9.80%
22	4.68%	4.68%	4.68%	4.68%	4.68%	4.46%	4.65%	4.64%	4.54%
23	2.27%	2.28%	2.27%	2.27%	2.28%	2.22%	2.23%	2.22%	2.15%
24	17.85%	18.18%	17.82%	18.01%	18.09%	19.04%	17.00%	16.88%	15.84%
25	7.50%	7.80%	7.47%	7.64%	7.71%	8.99%	6.83%	6.74%	6.05%
26	2.72%	2.85%	2.70%	2.78%	2.82%	3.45%	2.42%	2.38%	2.10%
27	1.59%	1.68%	1.58%	1.63%	1.65%	2.07%	1.40%	1.38%	1.20%
Prof.	15.12%	16.46%	14.99%	15.71%	16.06%	23.77%	12.51%	12.18%	9.96%
	100%	100%	100%	100%	100%	100%	100%	100%	100%
ExpectedSalary	29,340	29,570	29,310	29,450	29,530	31,140	28,810	28,740	28,220

Note: The first column of the table gives the probability of our reference academic, given his portfolio of characteristics, of being paid according to each spinal point of the salary scale. The second, third, fourth….etc column then gives the probability of finding our academic being paid on each of the spinal points of the salary scale, given that he changes his portfolio by one additional book, chapter in a book, paper, grant award, by acquiring teaching skill, by taking a 1 year career break, or by becoming a woman, or finally by taking a 1 year career break while being a woman. The final row of the table gives the reference academic's expected salary for each of the new portfolio scenarios. E.g the reference academic with his given portfolio has an expected salary of 29,340 GBP. Increasing his publication record by 1 refereed article would increase his salary to 29,450 GBP. Taking a break from the labour market for one year would decrease his expected salary to 28,810 GBP. If he had been female and had taken a one-year career break, his expected salary would have been 28,220 GBP.

TABLE 7

OLS Estimation Results for Reservation Salary

Dependent variable	Reservation salary as percentage deviation from actual salary (=100* ((wr-wa)/ wa)					
	Full sample		Excluding Professors		Professors only	
	par.	(s.e.)	par.	(s.e.)	par.	(s.e.)
Individual characteristics						
Intercept	32.128	(17.475)	2.349	(28.059)	-328.312	(288.519)
Male	1.305	(3.202)	2.768	(3.076)		
UK Citizen	-3.572	(3.950)	-3.475	(3.789)		
Job characteristics						
(w/10,000)	-25.130	(14.374)	2.127	(25.807)	149.518	(144.507)
$(w/10,000)^2$	4.787	(2.321)	-0.448	(5.408)	-14.315	(17.990)
Experience	0.973	(0.658)	0.476	(0.674)		
$Experience^2/10$	-0.160	(0.170)	-0.053	(0.186)		
Tenure	0.117	(0.623)	-0.686	(0.671)	3.081	(1.830)
$Tenure^2/10$	0.117	(0.203)	0.377	(0.220)	-0.661	(0.562)
Time-out	-0.377	(1.057)	-0.314	(0.993)		
University						
Aberdeen	0.517	(4.074)	2.487	(4.319)	-7.399	(12.662)
Dundee	0.828	(3.498)	1.262	(3.422)	0.578	(18.704)
Heriot-Watt	-3.166	(5.534)	-2.672	(5.906)	11.164	(16.974)
St.Andrews	2.623	(3.888)	3.776	(3.934)	-9.518	(14.316)
Faculty						
Arts	-5.590	(4.024)	-0.658	(4.074)	-22.090	(14.743)
Engineer	6.781	(4.369)	7.158	(4.420)	-6.032	(17.128)
Medicine	-0.788	(4.167)	-0.166	(4.142)	-2.046	(19.040)
Social Sciences	-0.250	(4.228)	2.073	(4.396)	-11.972	(15.110)
Publications						
Books (weighted)	0.376	(0.715)	-0.874	(1.118)	3.039	(1.314)
Chapters (weighted)	-1.678	(0.908)	-0.059	(1.052)	-4.236	(2.230)
Papers (weighted)	2.229	(1.328)	4.641	(1.973)	-1.362	(2.468)
Other						
Grants (weighted)	-0.106	(1.161)	-1.621	(1.404)	2.123	(2.791)
Having PhD	-0.291	(3.157)	-0.999	(3.234)	-20.392	(12.635)
Teaching skill	3.516	(3.551)	5.664	(3.733)	-24.964	(11.948)

Note: wr = reservation wage based on the answer to what is the lowest salary that you would accept in order to move jobs, wa = actual wage based on the answer to what is your annual salary that is before any deduction for tax, national insurance, pension contributions, union dues and so on. Standard deviation in parentheses.

Appendix A: Estimation of spinal point and salary scale model

We observe annual salary and payment scale, such as Lecturer A or B, for all respondents in our sample. Only 26 respondents gave their exact spinal point on the scale. But as several respondents gave an annual salary which fits exactly to a certain point on the salary scale, we can identify a spinal point for an additional 165 respondents. Since there is no formal spinal point system for professors, we model the position of a professor as being spinal point 28. Table A.1 outlines the distribution of academics across pay scales. To model the scales and salaries simultaneously, one has to acknowledge that these are outcomes of the same underlying process. As neither of these two kinds of information is perfect, it makes sense to incorporate both pieces of information in a model. To recapulate: the data on the salary scales in not perfect as for the largest part of our sample we only know the respondents' academic position; the data on the wages is not perfect as it clearly contains measurement error.

In total, we find that 69 respondents report an annual salary that is below their minimum salary. Although several of these cases might be due to rounding errors in salary, 39 respondents report a wage which is in line with a lower spinal point. Of these 39 respondents, 16 respondents aged 27 or older report a salary that is consistent with a point below the minimal spinal point at age 27. The question is whether this is due to measurement error in our background variables, or whether these individuals really accepted too low a wage. The problem also occurs among the professors - 3 out of 91 professors report a salary that is below the professional minimum of £31,158 in 1994. So although there is an official minimum point, it is an open question whether it is really effective in practice. For the purpose of our analysis, we estimate two models, a model with, and a model without restrictions. In the model with restrictions, we exclude the 39 academics that are paid on, we argue, too low a salary point. Results for this analysis are presented in table 8. Only the constant term differs in significance between the two models.

Model without restrictions

The likelihood contribution for an academic i in scale j and wage w_i is:

$$P(s_i=j, w_i) = P(s_i^* \leq T^{j+1}, w_i) - P(s_i^* \leq T^j, w_i)$$
$$= [P(s_i^* \leq T^{j+1} \mid w_i) - P(s_i^* \leq T^j \mid w_i)] P(w_i)$$

with for non-professors ($j \leq 27$):

$$P(s_i^* \leq T^j \mid w_i) = \Phi((T^j - x_i'\beta - (\rho/\sigma)(w_i - w^j)) / \sqrt{(1-\rho^2)})$$
$$P(w_i) = \varphi((w_i - w^j)/ \sigma)$$

and for professors ($j=28$):

$$P(s_i^* \leq T^j \mid w_i) = \Phi((T^j - x_i'\beta - (\rho^*/\sigma^*)(w_i - z_i'\gamma)) / \sqrt{(1-\rho^{*2})})$$
$$P(w_i) = \varphi((w_i - z_i'\gamma)/\sigma^*)$$

Note that the standard deviation of ε_i^s is set to one. Note also that for this model the correlation between the error-terms of the wages for the non-professors and professors is not identified. For a comparable result, see the Tobit Type 5 model of Amemiya (1984).

Model with restrictions

The likelihood contribution for a non-professor i in scale j and wage w_i is:

$$P(s_i=j, w_i \mid s_i \geq m) = P(s_i=j, w_i) / P(s_i \geq m) \qquad (j \geq m)$$

As the nominator is the same as for the model without restrictions, the derivation of the likelihood contribution is furthermore straightforward. For estimation we deleted the 39 individuals with j<m from the data. The likelihood contribution for a professor i with wage w_i is:

$$P(s_i=28, w_i \mid s_i \geq m, w_i \geq w_i^m) = P(s_i=28, w_i) / P(s_i \geq m, w_i \geq w_i^m)$$

Again the nominator is the same as for the model without restrictions. For 3 professors with a reported salary below the professional minimum, we set the salary equal to this professional minimum. Note that for this model the correlation between the non-professional and the professional wage is identified. Still the maximum likelihood procedure (of GAUSS) has problems to optimise the likelihood with respect to this parameter. As this parameter is only identified on the basis of the data on the professors, and the minimum scale restriction is of little importance for the professors, this is not a surprise. We set this correlation equal to zero.

TABLE A.1

Observations on Spinal Points of Salary Scale

Spinal point		Academic	Research staff
4	(3 obs.)		
5	(11 obs.)		Grade I.B
6	(17 obs.)		(26 obs.)
7	(9 obs.)	Lecturer A	
8	(8 obs.)	(58 obs.)	Grade I.A
9	(12 obs.)		(77 obs.)
10	(7 obs.)		
11	(10 obs.)		
12	(9 obs.)		
13	(8 obs.)		
14	(2 obs.)		
15	(7 obs.)	Lecturer B	Grade II
16	(3 obs.)	(88 obs.)	(13 obs.)
17	(6 obs.)		
18	(18 obs.)		
20	(11 obs.)		
21	(6 obs.)		
22	(3 obs.)		
23	(2 obs.)	Sen.lec./Reader	Grade III
24	(14 obs.)	(89 obs.)	(2 obs.)
25	(6 obs.)		
26	(2 obs.)		
27	(3 obs.)		
		Professor (91 obs.)	

Appendix B: Sensitivity Analysis

TABLE B.1

Ordered Probit Salary regression - Sensitivity Analysis on Gender (Comparison with table 6)

Dependent variable	Spinal point							
	Without time-out and productivity		Without productivity		Basic regression (from table 6)		Interaction of time out and gender	
	par.	(s.e.)	par.	(s.e.)	par.	(s.e.)	par.	(s.e.)
Individual characteristics								
Intercept	0.3106	(0.3619)	0.2983	(0.3580)	0.4076	(0.3799)	0.3960	(0.3813)
Male	0.3024	(0.1319)	0.2363	(0.1337)	0.1109	(0.1385)	0.1348	(0.1419)
UK Citizen	0.1296	(0.1715)	0.1549	(0.1715)	0.1266	(0.1763)	0.1267	(0.1766)
Job characteristics								
Experience	0.1973	(0.0253)	0.2110	(0.0260)	0.1929	(0.0271)	0.1933	(0.0271)
Experience²/10	-0.0281	(0.0062)	-0.0306	(0.0063)	-0.0274	(0.0068)	-0.0274	(0.0068)
Tenure	0.0633	(0.0251)	0.0565	(0.0253)	0.0201	(0.0268)	0.0187	(0.0269)
Tenure²/10	-0.0151	(0.0082)	-0.0134	(0.0082)	-0.0054	(0.0086)	-0.0048	(0.0086)
Time-out			-0.0929	(0.0338)	-0.0952	(0.0351)	-0.0838	(0.0378)
Time-out * gender							-0.0774	(0.0955)
University								
Aberdeen	0.2342	(0.1696)	0.2472	(0.1705)	0.1704	(0.1768)	0.1750	(0.1778)
Dundee	-0.0229	(0.1456)	-0.0137	(0.1487)	0.0445	(0.1526)	0.0420	(0.1550)
Heriot-Watt	0.3600	(0.2462)	0.3733	(0.2471)	0.5524	(0.2579)	0.5572	(0.2590)
St.Andrews	0.0771	(0.1633)	0.0862	(0.1643)	-0.0655	(0.1709)	-0.0750	(0.1726)
Faculty								
Arts	-0.0846	(0.1644)	-0.0823	(0.1646)	0.1021	(0.1749)	0.1049	(0.1762)
Engineer	-0.2111	(0.1833)	-0.2037	(0.1838)	-0.2895	(0.1905)	-0.2782	(0.1926)
Medicine	0.0983	(0.1795)	0.1226	(0.1803)	-0.0207	(0.1904)	-0.0166	(0.2007)
Social Sciences	0.2661	(0.1712)	0.2832	(0.1718)	0.3611	(0.1859)	0.3662	(0.1881)
Publications								
Books (weighted)					0.1165	(0.0369)	0.1204	(0.0374)
Chapters (weighted)					-0.0216	(0.0254)	-0.0226	(0.0255)
Papers (weighted)					0.3614	(0.0747)	0.3594	(0.0749)
Other								
Grants (weighted)					0.1333	(0.0462)	0.1343	(0.0464)
Having PhD					0.2323	(0.1423)	0.2445	(0.1439)
Teaching Skill					0.3229	(0.1527)	0.3171	(0.1534)

TABLE B.2

Ordered Probit Salary regression - Sensitivity Analysis on Productivity (comparison with table 6)

Dependent variable	Spinal point					
	Basic regression (from table 6)		Interaction of age and productivity			
	par.	(s.e.)	par.	(s.e.)		
Individual characteristics						
Intercept	0.4076	(0.3799)	0.4369	(0.3881)		
Male	0.1109	(0.1385)	0.1072	(0.1384)		
UK Citizen	0.1266	(0.1763)	0.1224	(0.1759)		
Job characteristics						
Experience	0.1929	(0.0271)	0.1888	(0.0277)		
Experience²/10	-0.0274	(0.0068)	-0.0263	(0.0068)		
Tenure	0.0201	(0.0268)	0.0191	(0.0272)		
Tenure²/10	-0.0054	(0.0086)	-0.0049	(0.0087)		
Time-out	-0.0952	(0.0351)	-0.0941	(0.0353)		
University						
Aberdeen	0.1704	(0.1768)	0.1735	(0.1773)		
Dundee	0.0445	(0.1526)	0.0605	(0.1528)		
Heriot-Watt	0.5524	(0.2579)	0.5620	(0.2580)		
St.Andrews	-0.0655	(0.1709)	-0.0468	(0.1725)		
Faculty						
Arts	0.1021	(0.1749)	0.0880	(0.1755)		
Engineer	-0.2895	(0.1905)	-0.2961	(0.1909)		
Medicine	-0.0207	(0.1904)	-0.0362	(0.1911)		
Social Sciences	0.3611	(0.1859)	0.3455	(0.1866)		
Publications			(age<40)		(age>=40)	
Books (weighted)	0.1165	(0.0369)	0.1100	(0.0861)	0.1184	(0.0400)
Chapters (weighted)	-0.0216	(0.0254)	-0.0199	(0.0256)	-0.0199	(0.0256)
Papers (weighted)	0.3614	(0.0747)	0.4820	(0.1675)	0.3290	(0.0809)
Other			(age<40)		(age>=40)	
Grants (weighted)	0.1333	(0.0462)	0.1908	(0.1460)	0.1273	(0.0486)
Having PhD	0.2323	(0.1423)	0.1543	(0.1730)	0.3112	(0.1998)
Teaching Skill	0.3229	(0.1527)	0.3207	(0.2528)	0.3076	(0.1866)

Note: Young = Age less than or equal to 39, Old = age greater than or equal to 40. In the interaction of age and productivity, the chapters variable is constrained to be the same across the age split.

Appendix C: Comparable wage regressions

In this appendix we calculate straightforward wage regression to compare them to the results of our spinal point and salary scale model. Define w_i as the natural logarithm of the salary of individual i, x_i as a vector of explanatory variables, β as a parameter vector, and ε_i^w as an individual disturbance term.

(B.1) $$w_i = x_i'\beta + \varepsilon_i^w$$

The OLS results are given in table B.1. We consider salary determination of our full sample of academics, of academics excluding professors and of professors only. Note that the results of the last two regressions should be interpreted with care, as selection effects play a role.

For the full sample we reveal an insignificant reward to male academics above female. As for the salary scale model, excluding the productivity variables from the analysis reveals a significant gender-wage gap at a one percent significance level. Experience is positively rewarded and spells outside the labour market have a significantly negative effect on academic salaries. Academics in Heriot-Watt experience a significant salary advantage relative to the excluded university Glasgow. Results reveal significantly positive rewards to productivity variables such as the number of books and papers published, grants awarded and high teaching ability. Overall the conclusions are in line with the results from the salary scale model.

Comparison of these results with those of academics excluding professors reveals similar patterns, although the reward to tenure is now significant. As stated in the beginning of this paragraph, the results should be taken with care as selection effects might play a major role here. For academics with much experience, tenure, and publications, becoming professor is a likely event. As the professors are excluded, the impact of these variables might be biased considerably. The same holds for the regression on the wages of the professors. Notice the negative impact of the number of books written, and also the n-shaped effect of tenure is negative after 8 years. Although this result is in line with Ransom (1993), it does not seem very reasonable to draw strong conclusions on the basis of these results.

TABLE C.1

Comparable Wage Regressions

Dependent variable	Natural logarithm of salary					
	Full sample		Excluding professors		Professors only	
	(635 obs.) par.	(s.e.)	(544 obs.) par.	(s.e.)	(91 obs.) par.	(s.e.)
Individual characteristics						
Intercept	9.5589	(0.0270)	9.5831	(0.0236)	10.5230	(0.0436)
Gender	0.0243	(0.0149)	0.0010	(0.0127)		
Citizen	0.0263	(0.0190)	0.0094	(0.0161)		
Job characteristics						
Experience	0.0329	(0.0025)	0.0267	(0.0023)		
Experience²/10	-0.0045	(0.0006)	-0.0039	(0.0006)		
Tenure	0.0029	(0.0027)	0.0122	(0.0026)	0.0040	(0.0041)
Tenure²/10	-0.0011	(0.0009)	-0.0028	(0.0008)	-0.0018	(0.0013)
Time-out	-0.0171	(0.0037)	-0.0116	(0.0031)		
University						
Aberdeen	-0.0013	(0.0185)	-0.0047	(0.0172)	0.0062	(0.0324)
Dundee	-0.0050	(0.0162)	0.0110	(0.0142)	-0.0046	(0.0422)
Heriot-Watt	0.0599	(0.0262)	0.0685	(0.0250)	-0.0562	(0.0418)
St.Andrews	-0.0008	(0.0180)	-0.0041	(0.0162)	0.0614	(0.0336)
Faculty						
Arts	0.0089	(0.0184)	0.0111	(0.0166)	-0.0088	(0.0354)
Engineer	-0.0302	(0.0199)	-0.0379	(0.0178)	0.0461	(0.0422)
Medicine	0.0090	(0.0199)	0.0020	(0.0177)	0.0753	(0.0447)
Social Sciences	0.0500	(0.0191)	0.0428	(0.0176)	-0.0074	(0.0347)
Publications						
Books (weighted)	0.0096	(0.0032)	0.0060	(0.0040)	-0.0045	(0.0034)
Chapters (weighted)	-0.0013	(0.0025)	0.0005	(0.0025)	-0.0051	(0.0040)
Papers (weighted)	0.0443	(0.0058)	0.0325	(0.0074)	0.0038	(0.0063)
Other						
Grants (weighted)	0.0231	(0.0045)	0.0165	(0.0045)	0.0079	(0.0068)
Having PhD	0.0246	(0.0146)	0.0449	(0.0132)	-0.0379	(0.0307)
Teaching Skill	0.0566	(0.0157)	0.0507	(0.0147)	0.0396	(0.0262)